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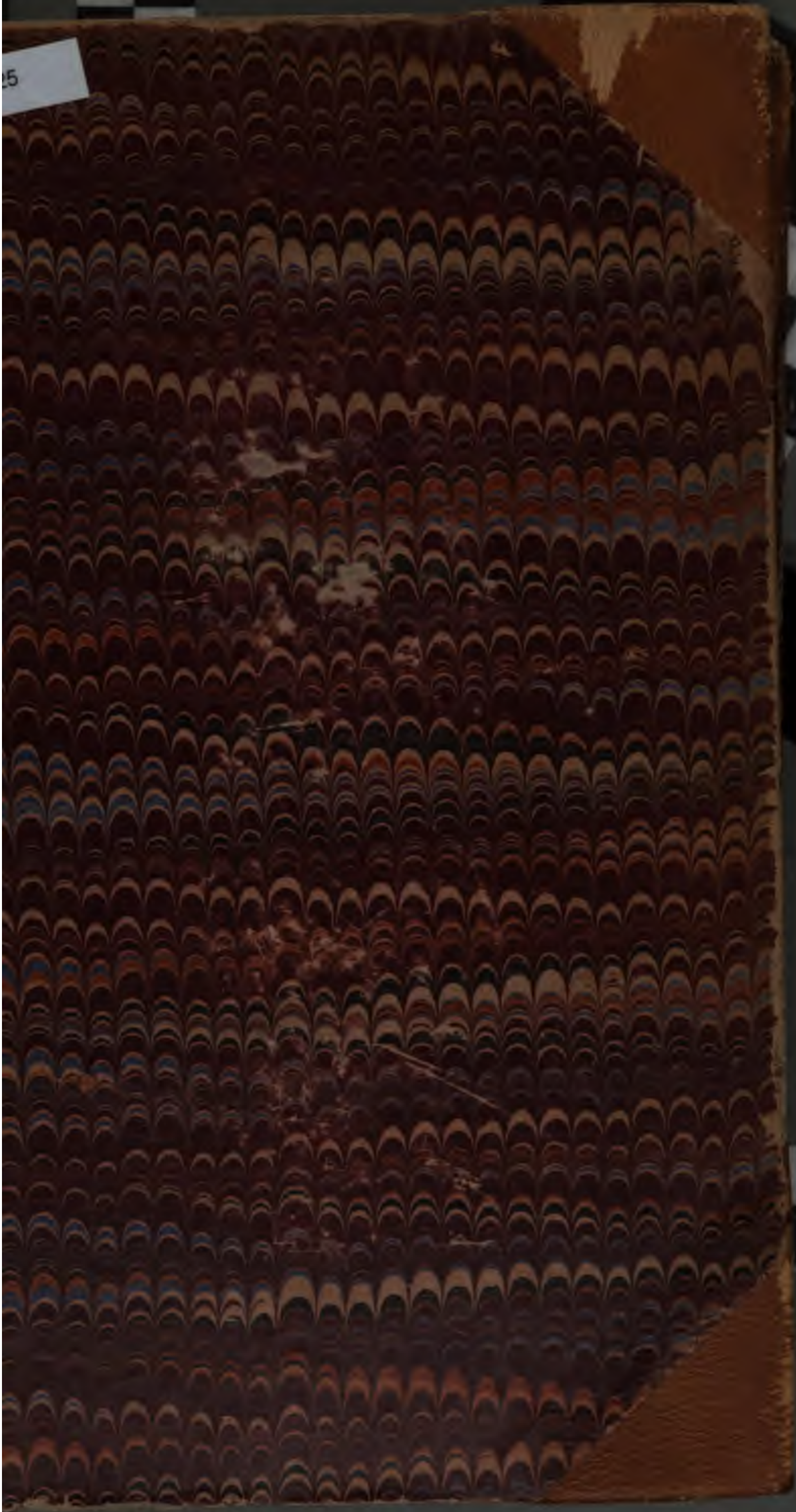

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stream, and can be traced northward, the whole length of the depressed plain, until they are cut by the Mississippi gorge. The eastern one is also seen running southward to the river and keeping nearly parallel with, but a few rods east of, the larger gorge in which Minnehaha now flows. Part of the water of the Mississippi manifestly once flowed along this level area and, plunging down over its abrupt southern end, which marks the locality of an ancient water-fall, followed the present course of Minnehaha to the river. (The channels referred to are shown in the accompanying map and sections.)

Prior to the recession of the falls of St. Anthony from Ft. Snelling to the present mouth of Minnehaha creek, the Mississippi was flowing in a broad shallow channel, in which there were very probably many islands. The remains of one of these islands are seen just above the junction of the two streams. When the falls had reached the lower end of this island, they were divided,—one part going to the east of the island and the other to the west. The stream on the eastern side was much the larger and the growth of its gorge more rapid, reaching the upper end of the island before the stream on the western side had eaten back to the same point. Thus the water of the latter stream was intercepted and carried down by the other, leaving the present deserted channel. No case similar to this has been personally noticed in the Mississippi gorge, although further search might reveal several additional instances. At the present time, however, St. Anthony falls are divided by an island in such a manner that one channel has approximately only one-third the volume of water of the other. If the wearing back of the falls here had not been artificially stopped, in all probability another deserted gorge, exactly similar to the one described, would have finally resulted, the deserted rock brink being on the east side of Hennepin island.

While the upper Mississippi still continued to receive large amounts of water from the melting of the retreating ice-sheet, towards the end of the second glacial period, its volume was much larger than now, and it was flowing in a broad channel many times the width of the present one.[4] After the ice had retreated so that the water flowing from it was drained to the sea in another direction, the Mississippi decreased to about its present size and then, but not before, cut its channel down through the drift to the Trenton limestone. As the hard limestone layers offered considerable resistance to erosion and as the drift banks offered much less, the river would be compelled to widen its channel rather than to deepen it; thus a broad, shallow stream would result. That the river had worn down to the limestone and was flowing along its surface long before cutting its gorge is noticed in several places. It is especially well shown in the wide shallow channel above the ancient falls, where the limestone layers are everywhere at the surface, being covered by only a few inches of soil which has accumulated since the water was drained from this channel. (Compare section CD.)

---

[4] Geol. and Nat. Hist. Survey of Minn., v. II, p. 337.

Another subject of noteworthy interest in this connection is the fact that the river did not cut its gorge of the same width as the channel in which it was flowing just before wearing through the limestone. In many places are found the remnants of old river terraces several rods beyond the limits of the gorge. This is shown on a small scale in the deserted channel described, where the distance between the terraces is much greater than that between the walls of the gorge, and there are no intermediate banks showing a diminution of the water or a narrowing of the channel after these terraces were formed and before the gorge was cut. And again, the Mississippi above the falls of St. Anthony has a much greater width than has the gorge below the falls. This could be explained by the stream's wearing away the limestone more rapidly at one side of the brink of the falls than at the other on account of its greater depth or on account of the softness of the rock; if once begun this would be continued by additional water which would be drawn to this point, and so one side of the falls would recede more rapidly than the other; and as a consequence, more and more water would be directed to this part of the channel until a portion of the brink had no water flowing over it, and would remain stationary. Thus it is probable that the river at first cut its gorge of width only sufficient to carry its volume of water; the size of the gorge has since been slightly increased by other causes mentioned below.

The effect of islands in rivers on the hastening of the final result of erosion,—the leveling of the drainage basin,—is of considerable importance. In the case under consideration

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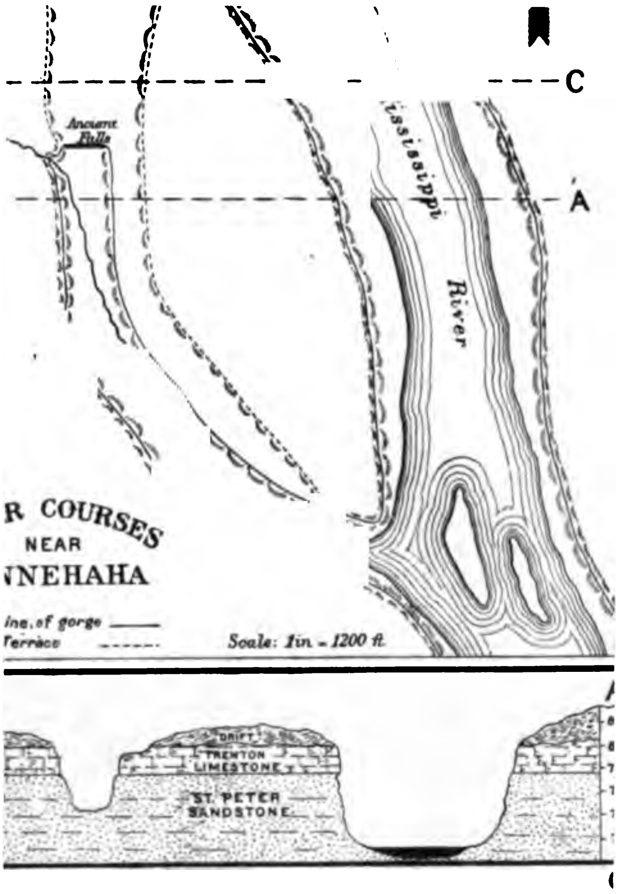
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THE

AMERICAN GEOLOGIST

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ACCOUNT OF A DESERTED GORGE OF THE MISSISSIPPI NEAR MINNEHAHA FALLS.

By Uly S. Grant, Minneapolis.

The present topography of any region, aside from a mountainous one—and even then to a great extent—is due almost entirely to the erosive power of water. The results which are most generally ascribed to this cause, probably because they form very striking features of our landscapes and can still be seen in the process of formation, are the channels cut by great rivers, especially the rock-bound passages usually termed cañons in the western states. One of these smaller channels, perhaps more appropriately called a gorge, will be briefly described; and a few of the accompanying minor results of erosion will be mentioned in regard to their assistance in the base leveling of a given area,—a subject which has been discussed recently in reference to the drainage of Pennsylvania.[1] It is not to be supposed that the comparatively insignificant effects here described are of great importance in the general planing off of large areas, but they undoubtedly are of considerable importance in the leveling of limited drainage basins, particularly in regions having a geological structure similar to that of the one under consideration.

From the falls of St. Anthony to Ft. Snelling, a distance of ssissippi through a [illegible] gorge f this region are covered by drift averaging, where the ıs cut through it, perhaps not more than thirty feet in ss. Immediately below the drift occur the practically ıtal beds of Trenton limestone, having a thickness of -seven feet, as is shown at the brink of Minnehaha falls. per and lower beds are of comparatively soft shales, but ater part is of hard, compact limestone. The Trenton nformably on the St. Peter sandstone, which is quite generally possessing very little or no cementing mate- The limestone forms the brink of every water-fall within ea, and in no place have the streams as yet cut entirely h the sandstone.

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[1] W. M. Davis: Nat. Geog. Mag., v. I, p. 183; Amer. Nat. v. XXIII, p. 566.

n its falls to the Mississippi, Minnehaha creek flows in ow gorge cut through the Trenton and some thirty feet e St. Peter. The upper part of this channel (the gorge of Minnehaha) is less than two hundred feet wide and s eastward for about six hundred and fifty feet; at this the channel enters an older gorge and widens abruptly e its original width and thence continues in a south- y direction undiminished to the Mississippi,—a distance -thirds of a mile. From the point where the channel sc nly expands, the older gorge not only runs, as before , southeastward to the river, but also extends north or some three hundred yards and ends abruptly.[3] Beyond rthern termination of this part of the gorge, which is now ed, a low, level plain, much wider than the deepe el below, passes northward and its upper end is seen t ne great gorge of the Mississippi at the top of the lime Each side of this level area is sharply defined b the river, after dividing, cut back its gorge much more slowly than when all its water was flowing in one channel; hence one effect is to decrease the rate of recession of falls. But on the other hand, the actual width of the two gorges taken together is greater than that of the gorge formed by the stream when undivided; so the width of the gorge is not directly proportional to the volume of the stream cutting it. That the gorge on the east side of the old island is of the same width as it is both above and below this point, is not due to the fact that it was originally cut of this size, but that it was enlarged after the water was again collected into the main channel. As the gorge proper of Minnehaha creek and that of the Mississippi remain practically constant in width throughout their courses, and for other reasons, it may be concluded that the respective volumes of these streams have also remained constant during the formation of their gorges. A comparison of these two gorges shows, as before stated: (1) That a smaller stream eats its way back much more slowly than a larger one; the Mississippi has cut its gorge from the old island to the present site of St. Anthony falls,—a distance of six miles,—in the same time which Minnehaha creek has required to cut a gorge of less than seven hundred feet in length. Prof. N. H. Winchell has calculated the average rate of recession of the falls of St. Anthony to be about five and a half feet per year;[5] from this determination Minnehaha falls would recede about one-tenth of a foot per year, or ten feet in a century. (2) That the width of a gorge is not directly proportional to the volume of the stream cutting it; the ratio between the width of Minnehaha gorge and that of the Mississippi is as one to five, but the volumes of the two streams are more as one to thirty.

In this connection it is to be noticed that it is almost impossible, unless a very long period of time is allowed, for the smaller streams to cut through the hardlime rock; but when once an opening has been made by the river, these streams rapidly increase the size of the opening by erosion of its edges and especially by the wearing away of the softer sandstone below, thus undermining and causing large blocks of the limestone to become detached. The width of a gorge is often materially increased by these smaller streams and by the rills from every shower; from this cause the gorge in close prox-

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[5] Geol. and Nat. Hist. Survey of Minn., v. II, p. 337.

ff the sharp outlines and to make the slopes more
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repared to take up and carry away large amounts of
rom below the limestone.

ect of islands in a river would then be to decrease the
h which the river cuts back its channel, but to in-
total width of the channels cut. There would thus
ly be a larger amount of material removed in a given
t even if the amount was not increased by this cause,
be by the additional sediment transported by the
treams. Hence the final effect is to accelerate the
of the leveling of the drainage basin.

pth of the gorge has not been taken into considera-
he river very rapidly cuts down into the sandstone
as once made an opening through the lime rock.

RIC RELATIONS OF PLATYCERAS AND CAPULUS.

By Charles R. Keyes.

time for forms now generally considered congeneric with Platyceras. But of late years many European authors have been inclined to regard the shells of the group in question as referable to the modern genus Capulus founded in 1810 by Montfort; though Œhlert[2] has recently revived Phillips' Acroculia,[3] proposed in 1841.

As regards the real generic characters of the different species, their specific limitations, range of variability and the geologic and geographic distribution of the various forms, greater confusion perhaps nowhere exists among fossil mollusks than in the group under consideration. This want of agreement among writers concerning the main features presented by the individuals of the various species is directly traceable to a number of causes. These, however, need not be reviewed here. Nor is it the intention in the present note to attempt a removal of the difficulties; but merely to call attention to several pertinent facts regarding the structural features of the fossil shells hitherto commonly referred to Platyceras of Conrad.

The most salient characters of recent Capulus, as shown by the more typical shells, are the more or less obliquely conical form, the small, often closely incurved spire, the broad, campanulate, apertural portions and the characteristic muscular impressions on the interior of the shell. The close relations of such paleozoic shells as *Platyceras paralium* W. & W. and *P. equilaterum* Hall and the modern forms of Capulus, as *C. hungaricus* Linn., can hardly be denied after even a casual comparison. The affinites are not less striking in many of the other forms. Nor are examples wanting from the Mesozoic.

The three hundred species which have been ascribed to Platyceras present such a great variety of forms that it is difficult to foresee just how they can be most satisfactorily arranged when they have been carefully considered anew and in relation to one another. The placing of Platyceras, Orthonychia and other sections as subgenera under Capulus, as has been done by Zittel,[4] and others, manifestly does not meet the requirements, at least so far as the American species are concerned. Whether or not the forms can all be included under Capulus remains for future comparison to decide. It

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[2] Bul. de la Soc. Géol. de France, (3), t. xi. p. 602.
[3] Palæ. Foss. Cornwall, p. 93.
[4] Handb. der. Palæontologie, II Band. p. 216.

oups somewhat beyond what has hitherto been con-
A recent critical examination of certain shells
as Platycerata also shows that some of these forms
rs of families entirely different from that supposed.
the group to which Conrad gave the name Platyceras
d one, it is very questionable whether the term could
smuch as it had been practically pre-occupied for
ee-quarters of a century. It has long been known
roy [4] in 1764 proposed, among Coleoptera, the generic
atyceras, a term which was later employed by
' and which continues to the present day in good
originally founded. In so far as the species hereafter
d are concerned, it matters little whether or not the
e genus Platyceras—*P. ventricosum* Con.—be a true
but certain it is that some of the forms described
former title are generically identic with the latter

ell known that the species that have been included
atyceras present a large variety of forms. And lately
en further shown that in this group variation is very
n among individuals of the same species. The man-
ses thus disclosed have resulted from the sedentary
f the mollusks; and in a number of species the for-
ects of attachment have proved to be the calyces of
. The evidence, however, bearing upon this question
given with considerable detail elsewhere [6] and is only
ally referred to here. Several hundred examples of
d embracing ten or a dozen different species of Platyce-
more than twenty species of crinoids show rathe

amply shown not to be the case. There are no grounds whatever for the assumption that the paleozoic Capuli led parasitic lives.

In this connection it may be stated that there is often considerable embarrassment in attempting to separate certain ancient Capuli on the one hand from some forms of Platyostoma, and especially from those species in which there is a greater or less tendency for the shells to uncoil; and on the other hand from various genera of patelloid shells.

As might be expected in a group of gasteropods presenting so few constant characters that can be satisfactorily relied upon in classification, it is often impossible to clearly distinguish between certain species of paleozoic Capulus. Many structural features long regarded as of much importance in identification are now known to possess little, if any, specific value, owing to their great variability. It has thus become necessary to consider as of the utmost significance the basis of species upon general resemblances rather than upon unimportant variant characters, due to the diverse condition of environment which arises from a more or less extensive geographic and geologic range. Therefore in the selection of characters for classificatory purposes it is evident that only those features showing the least tendency to change are available.

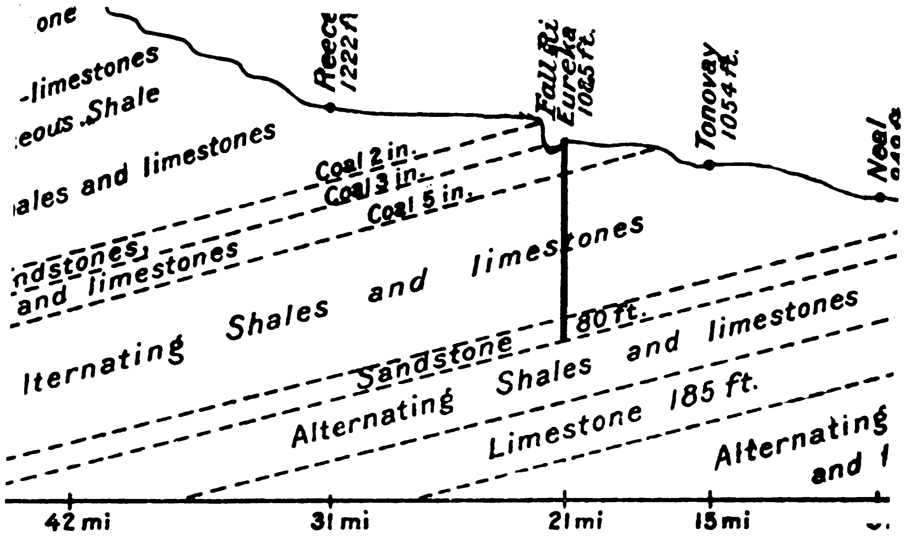
The following forms, originally described under Platyceras, appear properly to belong to Capulus. Doubtless quite a number of other American species that have been referred to the former genus should also be included.

C. occidens (Walcott.)
C. paralius (W. & W.)
C cyrtolites (McC.)
C. fissurella (Hall.)
C. latus Keyes.
C. quincyensis (McC.)
C. acutirostris Hall.
C. spinigerus (Worth.)
C. formosus Keyes.
C. biserialis (Hall.)
C. equilaterus (Hall.)
C. infundibulum (M. & W.)
C. obliquus Keyes.
C. tribulosus (White.)
C. chesterensis (M. & W.)
C. parvus Swallow.

THE PERMO-CARBONIFEROUS OF GREENWOOD AND BUTLER COUNTIES, KANSAS.

L. C. Wooster, Eureka, Kan.

Greenwood and Butler counties are situated in the southeastern part of Kansas in the basin of the Arkansas river. The surface slopes southeast and is drained by three miniature



ion in Permo-Carboniferous and Lower Coal Measures

Dip about 20 ft to the mi., West.

river systems: Verdigris river on the east, Fall river in the middle, and Walnut river on the west. The watershed between Verdigris river and Fall river is low, the two streams uniting a short distance south of the district described; but Fall river and Walnut river are separated by a well defined ridge which extends seventy-five miles south to the state line and beyond into Indian Territory. The summit of this ridge seen in the section on the opposite page has an elevation six hundred feet greater than Fall river at Eureka and nearly four hundred feet greater than the Walnut at Eldorado. The great abundance of flint nodules in the limestones of this watershed has given it the name, Flint Ridge, or Flint Hills, and the terraced slope and somewhat notched crest make it one of the most conspicuous topographic features of southern Kansas, especially when approached from the east.

The major inequalities of surface produced by the varying resistances of the subjacent strata to stream erosion are represented fairly well in the section opposite, but the details of the erosion surface could be given only in a relief map and must therefore be left largely to the imagination of the reader. Remembering that the surface has been subject to rain and stream erosion for some millions of years and that there is no protecting glacial drift to disguise the inequalities of rock surface, he can readily see that the level surfaces are limited to river bottoms and to stretches of upland, preserved by an underlying stratum of resistant limestone.

Before describing the strata of Carboniferous rocks exposed to view in the banks of all these streams from their sources to their mouths, it will be of interest to study some of the peculiar erosive features of the river valleys.

Fall river valley has the steepest slope of any in southern Kansas, showing a fall of seven hundred feet in forty miles. This great descent gives the river, scarcely fifteen square feet in average section, a high erosive power which has caused it to cut very deeply into the alternating shales and limestones of the Carboniferous.

Rising in the northwestern part of Greenwood county in the Permian of the Flint Hills, Fall river takes a southeasterly course obliquely across the outcropping edges of Permo-Carboniferous strata and the Lower Coal Measures to its place of junction with the Verdigris, sixty miles away. For most of

. The average fall of the river and its tributaries
c feet to the mile, the uplands and the slopes are
orests, so the average rainfall of between thirty
e inches is quickly drawn into its channel and
rd to the Arkansas. The narrow border of tim-
the stream is insufficient to restrain the flood and
nty-five feet in a single day is not uncommon.
ng torrent serves as a mighty plow and scraper.
d every year it works a marked change in its
d channel. The work of the river is aided by the
acter of the strata. The limestones and shales
nine feet and twenty-five feet in thickness, respect-
us the river for its entire length shows a succes-
des, rapids and deep quiet places. The border-
ough the varying resistant power of the strata,
h rain erosion, a similar succession of falls, be-
to the top.

valley of the Fall river, limited by bluffs frequent-
, hight of one hundred and sixty feet, is wide
he Mississippi river, and seems at first thought to
ence to a river nearly as great. But the fact that
d the neighboring streams hug, for the most part
stern side of their valleys, suggests a different ex-
The strata dip on the average about twenty feet
west by south, and consequently the rivers slide
side of their valleys and erode that border most
deeply. Deserted channels at higher levels are
n the other side of the valley, and give testimony

the genus Equus. Whether these were the skeletons of the Spanish horse or of the ancient American genus, Equus, is a problem which awaits solution.

I have stated that there is no glacial drift in these counties to serve as a protective covering to the subjacent rocks. While this is true, it is also true that glacial drift is not absent. A polygonal bowlder of granite in the writer's possession, weighing four hundred pounds, was found near the summit of a high ridge in the eastern part of Greenwood county, nearly buried from sight in shallow soil and sub-soil. A bowlder of coarse granite weighing about forty pounds was discovered in a similar situation near Eureka on the south side of Fall river valley. A third bowlder is reported from the southern part of Greenwood county, near Fall river, and a pebble of serpentine was shown the writer which had been picked up in a creek valley a few miles east of Eureka. But these are all I have been able to see or learn about, and their rarity makes them objects of much interest. One hundred miles north near Lawrence and Topeka, drift hills with bowlders are not uncommon, and these bowlders may have been sent off in floes or small bergs from a glacier front in the Kaw valley. But as they were lodged on a surface that now has a hight of eleven hundred feet above the ocean, their presence suggests either a much less relative elevation at this latitude, or a great thickness of ice and depth of flood in the first glacial epoch.

THE CARBONIFEROUS STRATA.

The influence of the Carboniferous shales, limestones and sandstones in determining the topographic features of southern Kansas has been briefly considered in the preceding pages. A detailed description of the thousand and one strata exposed between Toronto and Eldorado would be out of place in the GEOLOGIST. So the remainder of this paper will be given to a study of the dominant features of the rocks and life.

Following a precedent established by Kansas geologists, the term, Lower Coal Measures, will be applied to strata designated Lower and Middle Coal Measures in Iowa and Nebraska; and Permo-Carboniferous, to the Upper Coal Measures and Permian of other regions.

St. John estimates the thickness of the Lower Coal Measures as limited above at 600 ft. and the Permo-Carboniferous at 2200 ft. Between these formations there is no percepti-

the entire Carboniferous formation and will thus
useful horizon as a datum plane for the geologist. ne outcrops near the middle of Woodson and Wil- ›ining counties on the east and southeast, near the John has fixed as the eastern boundary of the)niferous, possibly with this stratum in mind.

he base of the Permo-Carboniferous thus estab- ıe summit of Flint Hills there intervene 1800 feet mestones and sandstones. The various outcrops the sandstones are limited to the lower 500 feet ıaceous shales to the lower 1,000 feet. The lime- ;hales are evenly distributed between the base and

bed of coal lies about 400 feet from the base, an- ɜt, three about 850 feet and the highest bed, little highly carbonaceous shale, about 1,300 feet.

ving tables will present other details of strata ob- outcrops in the eastern, middle and western por- district.

SHALES.		LIMESTONE.		SANDSTONE.	
No. of Strata.	Average Thickness.	No. of Strata.	Average Thickness.	No. of Strata.	Average Thickness.
4	18.5 feet	4	9.5 feet.	2	12.5 feet.
5	25 "	6	5 "	1	10 "
28	10 "	29	4.5 "	0	0 "

ls at Eureka, Fall River, Topeka and Emporia ır sections. All were sunk with a churn drill ex-

SHALES.	LIMESTONE.	SANDSTONE.

cept the well at Topeka which was bored with a diamond drill. The locations in the Permo-Carboniferous of the wells at Eureka and Fall River are shown in the section on page 10. The well at Topeka starts a little below the Eureka horizon and at Emporia a little above.

The records from the Eureka, Topeka and Emporia wells agree as closely as could be expected and correspond with the observed sections; but the Fall River record was not so carefully made, though the thicknesses of the strata are certainly somewhat greater in that part of the Permo-Carboniferous and Lower Coal Measures covered by the record. The Emporia well passed through three beds of coal in the first 500 feet and one bed in the last 500. This bed must belong to the Lower Measures.

In their lithological characteristics the lower shales are indistinguishable from the upper; and in all positions are nearly barren of fossils, except near the layers of limestone and in the calcareous or arenaceous portions.

The limestones of the Permo-Carboniferous are light to dark buff in color, usually very compact and well adapted for masonry. Outside the Flint Hills they are usually free from chert and very hard, almost glassy in their fracture. This is likewise true of many of the strata in the Flint Hills, but other strata are crowded with chert and are much softer under the hammer. Near the summit of the ridge and on the slopes towards Eldorado are the soft, light grey, almost white layers, so much prized for fronts and trimmings in the cities of Kansas. These upper beds, if any, belong to the Permian, and are persistent north and south across the state. Their thickness is unknown to the writer; but should the gypsiferous beds in the longitude of Wichita be placed in the Triassic, they, with the layers resting upon them, must exceed four hundred feet in thickness and not reach six hundred. This estimate is based upon the dip of the strata in the district covered by this paper, and on the belief that the line of junction with the Triassic was once near Wichita.

Of the 1800 feet of rock of our section in the Permo-Carboniferous, fully 1000 feet in round numbers is shale, 700 is limestone and 100 feet sandstone and argillaceous sandstone.

The sandstone strata are fine grained, and, as usual in the Carboniferous, hold many leaf and bark impressions. The

for building sand. The shallow water origin of th
is shown by ripple marks and leaf impressions.

ie of the thinner beds of limestone are ripple-marked
out most of it is heavy bedded, or at least contains t
ns of animals which frequent the deeper, purer wate
s the crinoids whose stalks make a large percentage
iterial of many of these layers, and many corals.

nce the deep sea then covering western Kansas a
Colorado would take to itself the debris of the weste
ains, we must look for the source of the material of t
ones and shales in the ancient mountains of Missou
of no mean extent and altitude, to furnish the thou
f cubic miles of sediments of the later Paleozoic form
f Missouri, Kansas and Nebraska.

reat was the diversity of conditions while these sec
were being deposited, so unequal and frequent were t
tions of the crust of the earth over eastern Kansas,
hat little reliance can be placed upon the thickness a
gical characters of the strata. It would seem that sha
nestone and even sandstone were being deposited at t
ime even in an area not larger than a congression
ip. The writer spent weeks, almost months, trying
series of strata from bluff to bluff on the same side
er and across the valley to the opposite side. Eve
ds were of little assistance for they varied greatly i
ss and extent. Fossils, the main reliance of the geol
d not help for they varied in the same stratum and th
pecies occurred above and below, with fortunately, hov
ie exception. A layer of limesto was at last disco

of the whole body of strata are more useful over wide areas. These he has endeavored to give in the preceding pages.

LIFE.

Fossils are about equally abundant in the lower, middle and upper portions of the Permo-Carboniferous, and are especially numerous in the limestones, and the calcareous and arenaceous shales. Certain genera such as Productus, Athyris, Spirifer and Chonetes are represented by the same species throughout the formation and are therefore of little use in determining horizons. These widely distributed species are: Productus semireticulatus, P. nebrascensis, P. longispinus, P. prattenianus, Athyris subtilita, Spirifer cameratus, S. (Martina) planoconvexus, Chonetes granulifera and Fusulina cylindrica.

Those species which thus far have been found only in the lower (Neal) portion of the formation are: Myalina subquadrata, Pleurotomaria turbiniformis, Schizodus wheeleri, Syringopora multattenuata, and buckhorn coral, species and genus unknown.

In the middle (Eureka) portion: Several undetermined species of Macrocheilina and Allorisima; Petalodus destructor Pleurotomaria perhumerosa, P. inornata, Euomphalus rugosus, Eirsocirnus sp.? and two undetermined species of Sigillaria.

In the Lower Flint Hills (Reece): Pseudomonotis hawni var. sinuata, Aviculopecten occidentalis, Meekella striato-costata, and Spiriferina kentuckensis.

In the Upper Flint Hills (Permian): Chænomya leavenworthensis, Pleurophorus subcuneatus, Myalina perattenuata and a Nautilus sp.?

The above determinations rest solely upon the writer's judgment. A more experienced palaeontologist would probably modify the list. The writer used Meek's Palaeontology of eastern Nebraska, vol. II of the Palaeontology of Illinois, and Dana's Manual, principally the first, in classifying his collections.

Some general statements respecting the life of the Permo-Carboniferous will probably be as helpful to the geologist as the above lists: Cup corals are much more abundant in the lower than in the upper half of the formation. One layer of limestone near Neal is an intertwined mass of Campophyllum torquium. Incrusting corals are everywhere common.

Crinoid columns are very abundant in the lower and middle t half as long.

urchins are represented by plates and spines in all
e formation.

nong brachiopods, Spirifer cameratus and Hemipr
us are remarkable for their wide range in size and
n, and Productus semireticulatus for its great siz
range. The last with P. nebrascensis is very comm
hert at the summit of the Flint Hills.

mellibranchs are widely distributed and belong
ly to the order, Asiphonia. The characteristic form
mentioned above; but many collected are as yet un
d.

steropods have likewise a wide range, and many
in unclassified. A single layer of limestone at E
yielded the major part of the collection. One, a M
-like gasteropod, measures three and one-half inche
ase to the apex and revolves eight times in the sam
. The Macrocheilinæ in the same layer rank ne

ambered shells and trilobites have thus far been
in the middle and upper strata.

arks teeth of the genus Petalodus occur in the E
on, and labyrinthodont foot-prints are found in lay
stone a short distance above the same horizon.

classified species of sea weeds, Calamites, ferns and
have been collected at nearly all horizons to the b
lint Hills, not above.

e writer has been especially interested in the fac

ON THE CONTACT OF THE HURONIAN AND LAURENTIAN ROCKS NORTH OF LAKE HURON.

By ALFRED E. BARLOW, M. A., Ottawa.

Read before the Logan Club, Ottawa, February 27th, 1890.

In this paper the writer proposes to bring forward some observations on the nature of the contact between the typical Huronian rocks of lake Huron and the Laurentian gneisses, which, it is thought, have an important bearing on the question of the origin and relative age of the latter. During the past five years he has had many opportunities, first as assistant to Dr. A. C. Lawson in the lake of the Woods and Rainy lake regions, and latterly as assistant to Dr. R. Bell in the country north of lake Huron, of becoming familiar with the phenomena of Archean geology and of studying particularly the conditions of contact where the Laurentian comes against the other rock formations of the Archean complex.

The Huronian area to the north of lake Huron is made up of a series of quartzites, graywackes, slate conglomerates, clay slates, hydro-mica, chloritic, epidotic and hornblendic schists, diabase and cherty limestones.

The majority of the clay slates have the appearance of being very little altered except in contact with the diabase and other igneous rocks and present in great part the same appearance as when hardened from the original soft sediments. The quartzites, graywackes and slate conglomerates have all been hardened and altered by the deposition of silicious matter between the component grains, and near the gneiss the two former species are altered into quartzose mica schists. In the neighborhood of diabase masses the slates and limestones are hardened and traversed by reticulating veins of secondary quartz, while the quartzites near igneous masses become more indurated and present veins of secondary quartz running parallel with the bedding, so that it is likely that the eruptive material has been the source of the heated solutions of silica. The Laurentian formation to the north of lake Huron is represented solely by orthoclase gneiss, a rock which may be described as essentially a crystalline admixture of feldspar, quartz and hornblende or mica, although in many cases both these last named minerals are present in the same rock mass. It is distinguished from granite only by its foliated texture, a structure produced by the parallel distribution of the compoɔrdinary eruptive granite.

srs. Logan and Murray, although they carefully e
nd mapped out the distribution of the different mem
Huronian system, almost ignored its contact wit
ntian, and it is only of late years that attention has
ed to the contact as a means of ascertaining the rel
f the two systems. In the absence of all fossil rem
the only criterion to determine the age of Lauren
in regard to the Huronian.

Robert Bell, in his report[1] on the geology of the n
od of the village of Shiboananing (Killarney) s
village itself stands upon red syenitic granite, w
ɔt at the sides, has a massive homogeneous struc
n a few instances a single reddish or yellowish g
streak an inch or two in thickness was observed run
ıortheasterly direction. Towards each side the gra
ɔck begins to assume a sort of parallelism or a gneis
ture." The junction between this and the Huro
ite and hornblende schists is seen at a rocky islan
about a mile north of the western end of "the pass
north side of which the village is built. "The gra
ked by a stratified rock of a reddish gray color con
a fine grained crystalline mixture of feldspar
." Both rocks have approximately the same north
rike, but while the Huronian beds are about vertica
oid gneiss dips southeast ∟ 50°. Dr. Bell refers
ɔid gneiss to the Huronian rather than the Lauren
gh he gives no reason for so doing. The coincidenc

meridian line) about six miles south of lake Panache, although the limit of the Huronian in this direction has not been ascertained with precision. In this vicinity it must turn to a more northerly direction for it passes about a mile to the east of lake Panache with a strike of N. 25° E.

The shores and islands of the eastern portions of lake Panache are occupied by a granular quartzite of varying shades of gray; mica in the form of minute desseminated scales and also feldspar are usually present in small quantities. About three miles from the contact with the gneiss, these Huronian quartzites show signs of great disturbance and the strike which has hitherto been nearly east and west turns abruptly to the southeast, this change being still farther continued till the strata just southeast of the lake have assumed a southeasterly strike, thus corresponding with the line of outcrop of the gneiss in this direction. A little to the north of this eastern end of lake Panache and emptying into it, is Gabodin lake, about two miles in length. At the western end or outlet of this lake micaceous quartzites were noticed with a strike of N. 75° E. which curves around quickly, for on the islands in the eastern part of the lake quartzose mica-schists were seen striking N. 15° E., these rocks being thus conformable with the line of outcrop of the gneiss in its northerly continuation. The rapid changes in the strike of the quartzites is accompanied by a very marked alteration in the character of the rocks themselves. The granular quartzites and sandstones which have previously shown no further signs of alteration than a hardening consequent on the interstitial deposition of silicious matter are now metamorphosed into very typical quartzose mica schists. The change is gradual but marked and extends to a distance of three miles from the line of junction.

The planes of bedding of the Huronian mica schists are parallel to the lamination of the gneiss. Both rocks have a strike N. 25° E. and a dip of S. 55° E. ∟ 75°, the mica schists, however, dipping into or under the gneiss. Penetrating the schists are lenticular sheets and patches of gneissic material of character and composition similar to the great mass of the gneiss in the immediate vicinity, to which they may often be continuously and directly traced. These intrusions of gneiss have disposed themselves usually in a direction parallel to the sing these intrusions is parallel to the walls of the en when these fissures cross the strike of the schist: ɜo demonstrates that gneissic lamination is causec w of the rock while viscid under differential pressures · fragments of the Huronian mica-schists are include eiss, the foliation of the latter conforming roughly egular outlines of the fragments. The flow structı ɔduced is always very marked. We have then t teria by which the presence of an eruptive mass ned: 1st, the penetration of the sedimentary st kes of the irruptive matter; 2nd, the occurrence of gments of these same beds in the irruptive mass its l, the metamorphism or alteration of the stratifie ng the line of junction. Evidence is also furnishe uptive character of this gneiss by the abrupt change ike of the mica schists in the vicinity of the line of the gneiss.

The line of junction was next seen on the western s ıvy lake about six miles in a direction N. 16° E. fr ce where it was examined east of lake Panache. Al has not been thoroughly explored through the inte ice, the boundary can be laid down with a very c ximation to the truth from a knowledge of the strik eiss in the neighborhood; for it has been noticed t ection of the line of demarcation depends not on th he Huronian schists or quartzites, but on the folia gneiss, whose line of outcrop is always parallel issic lamination in the immediate vicinity. In the of the lake, which is occupied by a tongue of highly inclined Huronian quartzites. At the southern edge of this trough the quartzites abut directly on the gneiss as on an irruptive mass, the strike of the former being N. 65° W. Dip S. 25° W. ∟ 50 while the foliation of the gneiss is N. E. Dip S. E. ∟ 75°.

At the northern edge of the trough the stratification of the quartzites corresponds in direction with the lamination of the gneiss. Both rocks strike S. 38° E. Although their declination is in opposite directions, the quartzites dipping S. 52° W. ∟ 80°. while the gneiss dips N. 52° E. ∟ 80.

The quartzites near the line of junction on Wavy lake are not so highly altered as on lake Panache, yet the proportion of mica in these rocks is seen to increase as the gneiss is approached. Where they abut on the gneiss, the quartzites are very much broken up and a jointed structure developed nearly parallel in direction with the line of contact. At the eastern end of the lake where the lamination of the northern and southern areas of gneiss converge in a common strike, angular fragments of various sizes of the Huronian micaceous quartzites were noticed embedded in the gneiss, the foliation of the latter flowing around the irregular outline of these fragments.

From Wavy lake the line of demarcation curves around very quickly from northwest to northeast and was next seen on the north shore of Chief's lake, on the south line of the township of Broder (Salter's base line) three and a half miles east of Long lake. Throughout this distance of nearly six miles, the general strike is northeast. Mr. Alex. Murray, who made an examination of the rocks exposed on Salter's base line simply describes the boundary here as a junction between "red gneiss" and "greenish mica slate."

The line from this point strikes due north into the township of Broder for about a mile when it bends around to the northeast for half a mile and then to N. 78° E. which general strike it maintains till the eastern line of Broder is reached.

Where this last abrupt change in the line of junction takes place the Huronian rocks with a strike of N. 75° E. and dip S. 15° E. ∟ 65° abut on the gneiss whose lamination has a direction of N. 40° E. and dip S. 50° E. ∟ 68°. Throughout the remaining part of the township of Broder, however, the micaceous slates and quartzites have approximately the same

een subjected to great pressure. Angular pieces o
tose rocks are included in the gneiss, especially nea
in the line of junction, while intrusions of gneiss
at several places penetrating the stratified rocks. In
nce a lenticular mass of distinctly laminated micac
s was seen intruded through the schists parallel to
ing at a distance of three hundred yards from the li
ct. Besides these gneissic intrusions there are irreg
ped fissures, running transversely to the strike of the sc
illed with coarsely crystalline feldspar and quartz. I
r portions of these veins, the feldspar and quartz
nt in about equal proportion, but where they begi
out, quartz seems to be the main, and, in some cases
constituent. These pegmatitic apophyses are evid
ons of the adjacent gneiss which have been inje
gh the schists and crystallized in the presence of he
rs. A large pegmatite vein of this sort was notice
ne between Broder and Dill, extending across the st
schists for a distance of half a mile from their co
the gneiss. Through the township of Dill the boun
ot been examined in detail, but it follows in gener
easterly course for about five miles when there is ano
t turn to the north, and the junction was again
ed to the west of a small lake which flows into
apitae river four miles below Wahnapitae Station on
lian Pacific railway. The whole line of contact f
lake to this point follows very closely the trend of
of lakes which form "The Whitefish River route."
ortage leading westward from this

is rendered more schistose or slaty by the incorporation of detached fragments of slate and quartzite elongated or flattened in the direction of the gneissic foliation.

Continuing still further northeast the boundary strikes the Wahnapitae river just below the Canadian Pacific railway bridge. The actual contact is not seen and the intervening space of one hundred and fifty yards between exposures of the two rocks is occupied by the river and a grassy flat. On the west side of the bridge are light greenish gray feldspathic quartzites with some thin interlaminated bands of darker colored sandy shale which have a strike of N. 65° E. and dip N. 25° W. ∠ 60°-70°. On the opposite bank of the river and near the railway station a dark gray, evenly laminated micaceous gneiss was noticed striking N 67° E. and dipping S. 23° E. ∠ 60.° Ruby colored garnets, arranged parallel to the foliation, are exceedingly numerous, the crystals frequently measuring from a quarter to half an inch in diameter.

The line of separation is occupied by the bed of the stream for a short distance when it again strikes inland, running parallel to the general course of the river. Through this distance of nearly six miles the contact is generally half a mile southeast of the river. The gneiss dips in a southeasterly direction at high angles, while the Huronian rocks with the same strike are nearly if not quite vertical. Apophyses of pegmatite are very often seen penetrating the silicious slates and quartzites which near the line of junction are altered into mica-schists. For nearly two miles further the contact is again concealed by the bed of the stream; but from this point it strikes across the country in a direction N. 60° E. for sixteen miles and was next seen by Mr. Murray crossing the Sturgeon river two miles below its confluence with the Maskinongé river. Nothing very definite, however, was ascertained regarding the relations of the two rocks at this place. Continuing on the same general course for twenty miles the line of division strikes the southern end of Cross lake. Here the Huronian slate conglomerate underlies the gneiss with perfect conformity, both rocks dipping S. 35° E. ∠ 56°. The slate conglomerate has very evidently been disturbed and altered near the line of contact and where the two rocks are in immediate juxtaposition a very perfect set of cleavage planes were noticed in the conglomerate dipping N. 50° E. ∠ 73°. At first these were mis-

Mr. Walter McQuat in his report of the Temiscami
gives a very detailed description of the junction a
on that part of the Ottawa river locally known
Quinze." He mentions especially the occurrence nea
tact of lenticular masses of a gneissic character in th
an hornblende schists which have a general directi
ponding with the bedding. In addition he notes the
through the Huronian at a considerable distance fro
of junction of a light gray granitic gneiss, whose fo
parallel to the stratification of the adjacent schists.
ticular irruptive mass measures six hundred yards lo
hundred wide and the direction of the longer axis co
with the strike of the schists. As the stream is asce
the great mass of the gneiss approached the sediment
show signs of great alteration and hornblendic, chlo
steatitic schists occupy the upper portion of the r
the junction the Huronian schists are seen to rest c
bly on the syenitic gneiss. Further to the north w
McQuat made a somewhat hurried examination the I
rocks everywhere near the contact with the gneiss,
abundant signs of disturbance and alteration conse
t irruption of the gneiss. The same geologist in hi
ion of the Blanche river which flows into the nort
of lake Temiscaming, notices the occurrence of two
gneiss separated from one another and apparently co
surrounded by Huronian schists. The southern area
ten miles across but the limits of the northern area
on the shores of Round lake at the head of this str
not ascertained. On the southeast as well as on th
west side of the southern area, the gneiss rests confor

it on his accompanying manuscript map as Laurentian gneiss, evidently deeming it of similar character and origin. The Huronian rocks in this district form a belt composed chiefly of quartzites, slates and conglomerates, which, starting from the northern shores of lake Huron extend in a northeasterly direction. The belt varies in breadth from about twenty-five miles in the vicinity of lake Huron to nearly one hundred miles in the Temagami region. At various places isolated areas of granitoid gneiss protrude through these sedimentary strata, the latter curving around the irruptive masses and conforming in general with their line of outcrop. An area of this kind, four or five miles in width, occupies the north shore of lake Huron, extending along the coast from Blind river to the vicinity of the mouth of the Thessalon. Another area was noticed north of Whitefish station on the "Soo" branch of the Canadian Pacific railway.

Dr. Bell has remarked the occurrence of two of these bosses on the Montreal river which may possibly be connected with the two areas seen by Mr. McQuat on the Blanche river. A boss of distinctly foliated flesh-red hornblendic gneiss occupies a portion of the shores of Carrying, McLean and Anima-nipissing lakes, which lie between lake Temagami and the Montreal river. The thinly bedded slate conglomerate through which this mass has been intruded is everywhere altered in contact with the gneiss. Near the line of junction the Huronian strata rest unconformably on the upturned edges of the gneiss. On Anima-nipissing lake where the immediate contact was examined the slate conglomerate inclines N. 50° W. ∟ 50° while the gneiss dips S. 85° E. ∟ 70°. Along the line of junction the slate conglomerate dips off the irruptive mass at high angles (50°-60°) while only a short distance away the declination is at a comparatively low angle (15°-20°).

On the western side of Wahnapitæ lake are exposures of a pale flesh-red hornblendic gneiss whose contact with the surrounding Huronian quartzite and diabase indicates its intrusive nature. The characteristic brecciated junction is everywhere displayed where the two rocks are seen in juxtaposition. Bands of gneiss penetrate the quartzite and greenstone while angular fragments of the two latter rock species are included in the gneiss which is distinctly foliated and indistinguishable from what is usually called Laurentian. This gneissic area is

The line of demarcation is very seldom a simple plar
rision, the breccia present along the line of junction fr
y covering a considerable space. It is therefore often
sible to draw an accurate line of division between th
ocks unless we assume that such a line should be
vhere the two rocks are present in about equal pro
The general correspondence of the gneissic intrusion w
tratification of the enclosing schists and the frequent
ar outline and parallel disposition of the detached sc
ragments in the gneiss often resemble at first sight ar
ating sequence of transitional beds. Again the cry
ondition of the Huronian feldspathic and micaceous
ites near the line of contact, which frequently resen
haracter and composition the more evenly laminated g
as been referred to as evidence of such a transitior
ven in such a case the bedded character of the Huro
a strongly marked contrast to the granitic aspect
neiss.

In conclusion then, the following facts seem to prove
doubt the irruptive nature of Laurentian gneiss and it
atic condition at a time subsequent to the petrifact
he Huronian sediments. 1. The diverse stratigraphi
tions of the two rocks along their line of junction.
equently perhaps the Huronian strata dip into or und
neiss, although very often this position is reversed a
Iuronian beds are seen superimposed on the gneiss wit
ct conformity. In many instances the two rocks
ertical positions side by side and occasionally the gnei

of an aqueous origin such explanation must be difficult and unsatisfactory. 2d. The alteration of the sedimentary rocks along the line of junction is a feature that has been invariably noticed where the contact has been carefully examined. 3rd. The inclusion of angular fragments in the mass of the gneiss which are clearly referable to the adjacent sedimentary strata. Near the line of junction these detached pieces have a clear and sharp outline while further in the mass where they have undergone partial fusion and absorption their outlines are blurred and indistinct. 4th. The occurrence of gneissic intrusions as well as more coarsely crystalline apophyses of pegmatite, both interlaminated with and transverse to the bedding of the Huronian rocks. These intrusions are distinctly irruptive and can often be directly traced to their source in the larger area of gneiss in the vicinity. 5th The absence of limestones, slates or quartzites or in fact any species of rock indicative of ordinary sedimentation. The crystalline limestones so far observed in the Laurentian in the lake Huron region are simply veins of calcite while the quartzites and mica schists sometimes seen interlaminated with the gneiss, are only quartzose and micaceous conditions of the more common feldspathic gneiss. 6th. The general character of the rock itself which in appearance and behavior has far more resemblance to an ordinary irruptive granite with a foliated texture, than an altered sedimentary rock. Sir. W. E. Logan himself in his notes of its occurrence on lake Temiscaming, invariably refers to it as "gneissoid syenite." The Huronian system therefore may be regarded as the oldest series of sedimentary strata of which we have at present any knowledge in this region. The original sediments must have been laid down on a firm floor whose composition judging by the character of the Huronian rocks must have been closely analogous to granite. The slates, conglomerates, quartzites and greywackes have all been derived from the waste of older feldspathic material. The laminated pebbles in the slate conglomerates indicate that this feldspathic floor had at least in places a foliated or gneissic structure. It was doubtless the fusion and subsequent recrystallization of this gneissic or granitic floor that gave rise to the Laurentian gneiss. The immense pressure exerted by the weight of the super-incumbent mass of Huronian strata, and the crumpling, folding and fracturing of the comparative-

must have taken place at a great depth below the ear
ent surface and subsequent upheaval and denundat
now exposed it. Strong evidence has been secured f
quent observations of the strike of the gneiss through
Huron country that a great part if not all of the region
terized by the presence of this rock is made up of hug
or irregularly oval shaped concentric areas which an
with one another. This concentric arrangement of th
sic foliation seems to indicate that the forces of upl
the gneiss have acted from certain centres. These
tions and conclusions indicate that the typical Huroni
a relation to the Laurentian precisely similar to th
has been established in the country northwest of lak
ior for the Keewatin and Coutchiching groups of r
Dr. A. C. Lawson.

Dr. A. C. Lawson very kindly undertook the exar
under the microscope of seven thin sections of both
show some of the contact phenomena, and below will l
the result of his investigations.

Slide No. 1. North shore of Archie bay, lake Panache, f
west of the contact.

This rock may be regarded as a typical specimen of the les
quartzite and a thin slice of it was examined under the micro
show its relations with the more altered micaceous quartzite
line of the junction. "A fine grained, light yellowish gray quar
"stained in places; under the microscope it is seen to be a
"quartz-sandstone. A cataclastic condition is seen to have been
"upon the original epiclastic grains of quartz; wavy extinctio
"mon. There is a rude parallel arrangement of the quartz
"long areas and between the constituent grains is a fine
"which is largely made up of a felt work of muscovite. In sc
"tions of the slide this felt work of muscovite is mixed wit
"grains of quartz and forms a

“the slide are numerous scales of brown biotite and a less proportion
“of muscovite. Most of these mica scales have a parallel arrangement
“but some are seen to have been developed in the curved lines or areas
“between the original clastic grains. Some of the quartz grains show
“evidence of pressure in the optical tension which they manifest under
“crossed nicols. Inclusions are not abundant in the quartz.”

“Slide No. 3. In contact with the gneiss east of lake Panache. A
“silvery micaceous, very quartzose schist, somewhat rusted, and with
“strongly micaceous sheen surfaces. Under the microscope the rock
“is seen to be composed essentially of quartz and muscovite. There
“is a well marked parallelism in the arrangement of the muscovite
“and the quartz shows distinct cataclastic structure, wavy extinction,
“arrangement in parallel areas and other crushed phenomena. Evi-
“dently an altered sandstone.”

“Slide No. 4. Contact east of lake Panache. The hand specimen
“before sliced showed two small bands of granitoid gneiss irruptive
“through it. “Dark greenish gray fine-grained quartzite traversed by a
“small stringer, three-quarters of an inch wide of rather coarse flesh
“red granite. Under the microscope the quartzite is a typical epi-
“clastic rock presenting no strong evidence of deformation by pressure.
“It consists of a heterogeneous aggregate of clastic grains of quartz and
“feldspar, much of the latter being plagioclase. In sections the shape
“of these grains is rounded, sub-angular or sometimes angular. The
“larger grains are imbedded in a base composed of much smaller grains
“of the same materials but intimately mixed with a green chloritic sub-
“stance which gives its color to the rock. The section crosses the con-
“tact of the granite stringer and the quartzite. The contact between
“the two is sharp but ragged and portions of the clastic rock are seen
“to have been incorporated in the granite. The granite itself is a
“coarse angular aggregate of orthoclase and quartz, with extremely
“little of the ferro-magnesian constituent. There is a certain amount
“of finer base in the granite of which it is difficult to say whether it is
“simply a later and more rapid consolidation of the magma about the
“larger constituents or whether it is a portion of the clastic rock which
“has been incorporated without fusion in the granite.”

Slide No. 5. Laurentian gneiss in contact with Huronian micaceous
quartzite, north shore of Wavy lake. “A reddish highly feldspathic
“granite with occasional shear planes traversing it. Under the mi-
“croscope the rock is a granular aggregate of orthoclase, quartz,
“plagioclase and biotite in which crush phenomena are to a
“limited extent apparent. The orthoclase is very much kaolinized
“in its central portion but quite fresh in the peripheral zone. The
“plagioclase is as a rule fresh. The biotite is very sparingly represent-
“ed and is almost entirely altered to chlorite. There is present also a
“little brown iron oxide. The effects of secondary pressure are seen
“on the occasional dislocation of the plagioclase crystals and in cata-
“clastic structure which has to a limited extent been developed in por-
“tions of the sections.”

Slide No. 6. Township of Broder, Concession III. Line between
“lots 4 and 5, 350 yards north of the contact with the gneiss. “A gray
“moderately fine textured schist, spotted with scales of brown mica
“and having uneven or lumpy cleavage surfaces, with marked silvery
“gloss. Under the microscope the clastic character of the rock is ap-
“parent, it being composed of grains of quartz and feldspar chiefly.
“Throughout this clastic aggregate there have been developed numer-
“erous plates of brown mica and some of muscovite nearly all in paral-
“lel position. Scattered throughout the slide are nests of separated or
“closely aggregated grains of a light yellow pleochroic mineral proba-
“bly epidote. The separate grains of epidote in each nest have for the

on one side of the specimen. thin section exam
"the contact of the granite gneiss and the schist. In the
"two rocks are very distinct and the contact while fairly
"portions of the schists included within the granite. Th
"granular aggregate of orthoclase, microcline, plagioclase
"tite and muscovite. Some of the orthoclase shows a zo
"the interior idiomorphic portions being more decompo
"outer zone whose form is allotriomorphic. A colorless
"strongly marked relief, probably garnet, was also obse
"crystalline boundaries. Some small shreds of chlorit
"parently from the decomposition of the biotite, are also
"tered through the granite. There is present in associat
"ritized biotite, some magnitite and also some opaque g
"probably also magnitite. Apatite occurs sparingly in sle
"and in stout oval bodies. In the structure of the rock th
"slight evidences of pressure seen in the occasional dis
"crystal of plagioclase but there is neither shearing o
"structure. The schist in contact with this granite is
"sheared and it only requires an inspection of the slide to
"shearing was affected before the magma from which the
"crystallized was brought in contact with the schist.
"composed essentially of quartz and muscovite and the
"rearranged in parallel thinly lenticular areas which wed
"another. The optical tension of the quartz lenses is ve
"The cataclastic structure of the quartz is pronounced.
"aspect of the schist is that of a streaky rhyolite.

ARTESIAN WATER FROM THE DRIFT.

By Chas. W. Rolfe, Urbana, Ill.

The presence, in the drift, of water-bearing ve
sufficient head to cause them to flow at the surface wh
is not a very uncommon occurrence, but the district
be described is, I think, remarkable for its size, an
with which flowing wells can be obtained over a lar
its area. This fact, and the many misconceptions o
ture as shown by the theories advanced to accou
water supply, have led me to think that a brief st

portions of Kankakee, Champaign and Vermillion counties. Its eastern boundary seems to agree essentially with the state line, and its western with the eastern side of Ford county. The area is approximately 1200 square miles.

Its general surface may be described as a level prairie sloping gently to the north with an average inclination of about three feet to the mile, and diversified here and there by ridges and groups of low hills evidently left as moraines by the retreating Lake Michigan glacier. The southernmost of these runs eastward from Rantoul, following closely the line of the narrow guage railroad.

The entire area is covered by a mass of drift varying in thickness from seventeen feet, seven miles north of St. Anne in Kankakee county, to more than three hundred feet in central and southern Iroquois county.

Records of borings and cuts, show that this drift is made up of a tough blue clay, which encloses here and there elongated masses of sand and gravel varying from a few inches to more than twenty feet in thickness. These sand beds are always surrounded by a layer of closer grained, more impervious clay called hardpan by the well borers, and are always water bearing.

In the more elevated portions of the area, no flowing wells, so far as I am able to find, have been obtained, but between and around these at lower levels many wells have been struck from which water can be made to flow above the surface to a hight which varies from a few inches to four feet, the usual limit. In two instances only that have come to my knowledge did the water rise to the hight of ten feet. One of these was at LaHogue near the Ford county line and the other that east of Penfield just over in Vermillion county.

The depth of the wells varies from five feet to over two hundred and seems to be entirely independent of surface elevation. At LaHogue the well mentioned above is ninety feet deep, while at Gilman, whose elevation is fifteen feet less, the wells are usually from one hundred to one hundred and twenty feet, and a few miles farther east, where the surface is twelve feet lower still, they are only sixty feet deep. Then again at Buckley, twelve miles south of Gilman and forty-five feet higher, the usual depth is only five feet. As a further illustration, two wells were bored not far from Gilman, one of which reached

ter at the depth of thirty-seven feet, while the other,
rods distant and on about the same level, only found
th of one hundred and eighteen.

al places in the county, there appear to be two ar-
zons, but on the other hand the presence of a flow-
nowhere a guaranty that another can be struck even
ds distance. Dry holes or "pump wells" are com-
of borings in all parts of the county. A farmer
eld in Champaign county has five flowing wells, in
ch water was found at forty-five feet, and again at
ed and fifty-eight, the water rising about two feet
surface each time, while a number of his neighbors
with no success.

theories have been advanced to account for the
f artesian water in this district, of which I shall only
e. The first, and perhaps the most plausible is that
gation of the Oregon-LaSalle fault permits the rise
om the St. Peter sandstone. In answer I would call
o the fact that the fault disappears a few miles south

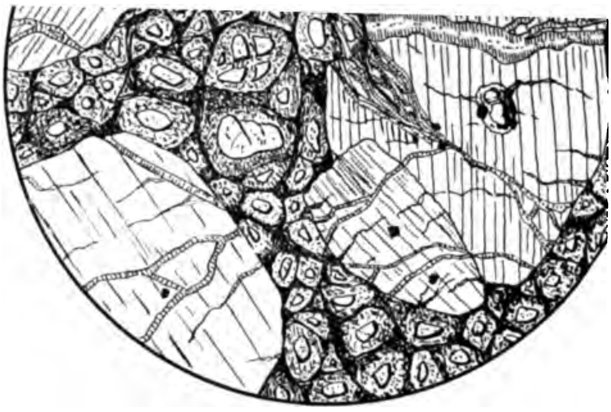
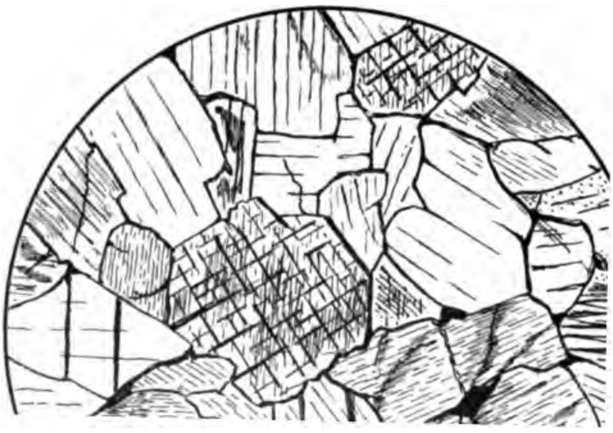


FIG. 1.
PORPHYRITIC LHERZOLITE.



seasons, built up as its ground moraine the immense mass of drift which, as we have seen, covers the whole area, and the ponds and streams arising from it at each recession assorted and deposited long lines of sand and gravel, of various breadth and thickness, having a small dip away from the higher portions, as it has been observed these patches actually do have. These in turn would be covered and others formed above them; and in this way the whole mass would be built up. The low dip would give to these lines of sand and gravel a broad outcrop near the higher portions and at the same time would carry it rapidly below the surface; a dip of one degree equals 92 feet per mile, so it is evident that even a much smaller dip than that indicated would carry the sand beds down to the level at which we find them, within a comparatively short distance from the highlands.

We believe then that the water-bearing sands derive their supply from the broad area which they expose among the hills, that the water is kept within them as in a pocket by the all but impervious layer of hard pan; and that when this is penetrated at a point where the surface is lower than the catch basin we have all the requirements for an artesian flow. The distribution of these bands through the drift will explain the occurrence of dry wells, of two or more water-bearing strata in a single well; of the variation in the depth of wells in the same neighborhood, and of the differences in head which the wells show.

THE NON-FELDSPATHIC INTRUSIVE ROCKS OF MARYLAND AND THE COURSE OF THEIR ALTERATION.

By GEORGE H. WILLIAMS.

1st Paper.

The Original Rocks.

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Occurrence and Association. The seventeen hundred square miles which compose the Piedmont plain or area of crystalline

aryland is divided by its watershed, known as Parr's
two distinct regions. Of these, the more western
mainly with chloritic and sericitic schists contain-
lated beds of limestone. This region is throughout
free from intrusive rocks of any kind, and in this
it presents a marked contrast to the more highly
gneisses and marbles of the eastern part of the
area. These are interrupted by large masses of
ks which possess a considerable variety and repre-
distinct types. These three types, in order of their
, are as follows:

lagioclase or gabbro type. This is the oldest as well
t extensive of the three. It embraces hypersthene-
d diorite, with from 44 to 48 per cent. of silica, a
mount of alkali and considerable alumnia.

non-feldspathic or magnesian type. This is closely re-
e first type but is of less extent. It embraces ser-
nd associated steatitic and hornblendic rocks,

Relation to the Serpentines. The serpentines of Maryland have long been known on account of the chromite they contain. They stretch in a series of lenticular and irregularly elongated areas along the Maryland and Pennsylvania state line on the northern border of Cecil county, whence they follow the great westward bend in the Appalachians through Harford and a part of Baltimore counties, and then turn to a southwestward direction along the eastern base of Parr's Ridge through a part of Baltimore and across Howard and Montgomery counties to the Potomac.

While by no means regular in their distribution, these serpentine areas lie for the most part on the west and northwest side of the gabbros. This fact is not without significance when taken in connection with the westerly or northwesterly dip of the crystalline schists, as indicating that the non-feldspathic eruptives and their alteration products are *younger* than the gabbros—a result which is quite in accord with all observations made on the field relations of these rocks where they occur together.

The serpentines of Maryland, as well as the extensive hornblendic and steatitic masses with which they are intimately connected, are plainly of secondary origin. They have all been produced by the alteration of what were once basic eruptive rocks, devoid of feldspar, which are still to be found in an almost unchanged condition. From these original rocks the serpentines and their associates can be traced through every intermediate stage so as to leave no doubt as to the exact course of their alteration.

Character of the Original Non-feldspathic Rocks. The original rocks from which the Maryland serpentines and their associates have been derived belong to two distinct, but closely related groups. The members of both of these groups are alike in being too poor in alumina to produce any feldspar, while the mineralogical differences which divide them are mainly due to the smaller or larger percent of silica that they contain.

The rocks of the group poorest in silica (40-44%) are richest in magnesia and are characterized by *olivine* as an essential constituent. They are therefore representatives of the class *Peridotite*; and, according to their greater or less proportions

ay apply the class name, *Pyroxenite*. These rocks e:
e same variations in their proportions of lime as the
rs of the first group; and this gives rise to diallage-br
ıd pure bronzite aggregates which are equivalent to ol
e lherzolites and harzburgites respectively.

In their distribution, in the occurrence of every interm
rm, and in the similarity of their alterations, thes
oups are so closely related that it is impossible to r
em as anything but mineralogical facies of a single m
evertheless, their extremes represent two petrograph
stinct and well characterized types, which must be des
fore attempting to trace out their relationships.

I. *The Pyroxene-olivine Rocks—Peridotites.* This t
uch less common than the pyroxenite; not perhaps be
was originally less extensively developed, but rather be
is more subject to alteration, since olivine is a less
mpound under present conditions than pyroxene. Ir
even the freshest peridotite specimens obtainable, thi
ituent, olivine, is partially transformed to serpe
though not to an extent which disguises the original
e or character of the rock.

The Maryland peridotites have been already des
the writer in a former paper.[3] Their most rema
ature is their porphyritic structure, which is
Fig. 1, Pl. II. The groundmass appears in a
ecimen homogeneous, compact, and of a greenish
lor, but under the microscope is seen to be wholly
sed of small olivine grains, more or less completely ch
serpentine. Cores of the unaltered mineral frequent
py the central portions of the grains; and are con

structure indicates that the olivine is the youngest of the original minerals, and it seems therefore opposed to the rule, given by Rosenbusch[4] and others, that, in eruptive rocks, the order of crystallization is in inverse order of acidity, the most basic constituent forming first, etc. The porphyritic structure is always noticeable in the Maryland peridotites, but is much more pronounced in some cases than in others, owing to the larger size of the pyroxene crystals.

In these peridotites the pyroxenic component is always, wholly or in part, *bronzite*. With this is frequently associated *diallage*, which in some instances exceeds the bronzite in amount. The only other original constituent present is magnetite, except in those varietes where the development of a little basic feldspar produces a transition to olivine-gabbro.

In composition these peridotites are ultra-basic ferro-magnesian silicates, with a minimum amount of alumina. Their two varieties—olivine-bronzite aggregates(Saxonite, Harzburg ite) and olivine-bronzite-diallage aggregates (Lherzolite), are produced by the relative proportions of lime present in the crystallizing magma; and hence, as mineralogical facies of the same mass, merge imperceptibly into one another. Analyses of two specimens are here given. I shows the composition of a typical porphyritic lherzolite, from Johnny Cake road, Baltimore county, (No. 174) as determined by Mr. T. M. Chatard of the U. S. Geological Survey. This is the rock represented in Fig. 1. II is the analysis of a feldspathic lherzolite from a dike exposed on the Western Maryland railroad near Pikesville, Baltimore county, (No. 54). It was made by Dr. Leroy McCay of Princeton College.

	I.	II.	
SiO_2	43.87	41.00	
TiO_2	.12	—	
Al_2O_3	1.64	7.58	
Cr_2O_3	.44	—	
Fe_2O_3	8.96	5.99	
FeO	2.60	4.63	
MnO	.19	tr.	
CaO	6.29	10.08	
MgO	27.32	23.59	
Na_2O	.50	.52	
Ignition	8.72	H_2O 4.73 CO_2 3.62	8.35
Sp. gr. 3.022.	100.63	101.74	Sp. gr. 2.989.

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[4] Neues Jahrb. für Min., etc., 1882, II, p. 8.

of these rocks the presence of diallage manifests
e amount of lime which the analysis shows. In the
e presence of the basic feldspar (anorthite) is indi-
he greatly increased percentages of both alumina
The loss by ignition shows a large amount of water,
serpentinization of the olivine; and also, in the
tance, the carbon-dioxide proves extensive carboni-
he feldspar and diallage.

Pure Pyroxene Rocks—Pyroxenites. The masses of
ocks composed wholly of pyroxene, which are so
n Maryland and from which the steatites and possi-
f the serpentines have been derived, are even better
description than the peridotites. This is, 1st, be-
represent, in typical and extensive development, an
group of igneous rocks which has not heretofore
ts due recognition; and 2d, because the abundance
l in all states of preservation permits of the trac-
the course of their alteration.

re pyroxene rocks of Maryland exhibit two well

	III.
SiO_2	50.80
Al_2O_3	3.40
Cr_2O_3	0.32
Fe_2O_3	1.39
FeO	8.11
MnO	0.17
CaO	12.31
MgO	22.77
Na_2O	tr
K_2O	tr
H_2O (red heat)	0.52
Cl	0.24
	100.03

Sp. gr. 3.318

The microscopic appearance of this rock is represented (though of necessity very imperfectly without the use of color) in Fig.2,Pl.II. The two constituents do not differ materially in the depth of their color, but in the figure the hypersthene is shaded somewhat darker to distinguish it from the diallage. It is rare that either component of this rock exhibits any trace of crystal form, but when such is present it always belongs to the hypersthene, indicating that of the two, this mineral is slightly the older.

The type of rock here described is not uncommon at many localites near Baltimore, but it is to be found in its freshest and finest development along the Johnny Cake road, one mile east of the Patapsco river, and along Gwynn's Falls south of the road leading west from Pikesville Station. At the latter locality the rock often has an extremely coarse grain and it not infrequently contains porphyritic crystals of orthorhombic pyroxene an inch or two in length.

The second and more striking type of the Maryland pyroxenite is considerably poorer in iron, and hence lighter both in weight and color than the rock just described. Even in hand-specimens the two pyroxenic constituents present that contrast of color which in the former type is observable only in a thin section. The orthorhombic mineral is reddish brown while the monoclinic one is emerald green. The grain is in the main even, although a porphyritic development of the bronzite is sometimes observable. The cohesion between the grains is so slight that perfectly fresh specimens may sometimes be rubbed to powder in the fingers. This, together with the size of the individuals, renders the separation of the two

nts easy, even without the aid of a heavy solution.
st locality for unaltered specimens of this rock is
bville P. O., on the Windsor road, about six miles
altimore.
llowing analyses (IV and V) of two samples of this
by Dr. T. M. Chatard of the U. S. Geological Survey,
der VI and VII the composition of each of the two
composing rock V is given according to the same

IV.	V.	VI.	VII.
53.98	52.55	54.53	51.80
0.15	0.14	—	0.13
1.32	2.71	1.93	2.21
0.53	0.44	0.30	0.51
1.41	1.27	1.70	1.29
3.90	4.90	8.92	3.50
0.21	0.24	0.28	tr.
15.47	16.52	2.25	20.99
22.59	20.39	29.51	17.76
ndeterm.	0.27	—	—
		—	—
0.83	1.09	1.14	0.65

those of Damour, Oebbecke, Farsky, Cossa and Heddle, quoted by Teall (British Petrography, p. 89.)[5]

The extremely friable nature of this rock renders the preparation of thin sections difficult. Nevertheless its two components may be easily separated and studied independently. The structure is almost always granular; but whenever it is at all porphyritic, the bronzite is the older constituent, so that if correlated with the porphyritic peridotites above described, the diopside supplies the place of the olivine groundmass. This change is produced by an increase of the silica while the proportion of alumina remains too low to allow the formation of feldspar.

Occurrence of Pyroxenite outside of Maryland. Observations are not lacking which indicate that massive pyroxenites of both the types here described from Baltimore county, are extensively developed and widely distributed through the crystalline areas of the eastern United States, although our present knowledge hardly indicates what their real importance is.

Rocks of the first type, or bronzite-diallage aggregates, have been traced by the writer through Harford county, Md., in close connection with the serpentine of that district. Professor F. D. Chester has also recently described them as associated with, and giving rise to many of the state line serpentines of Cecil county, Md., and Chester and Lancaster counties, Pa.[6] It has also been long recognized that many other serpentines of Pennsylvania have originated from the alteration of pure pyroxene rocks, especially enstatite and bronzite aggregates.

Pyroxenites of the second type, bronzite-diopside aggregates, are known in the south, and the writer gladly avails himself of the kind permission of Mr. Geo. P. Merrill of the U. S. National Museum to describe in this connection certain very beautiful rocks of this type which he collected near Webster, N. C. They are abundantly exposed at this locality and form a member of the corundum-bearing dunite series which extends through North Carolina and Georgia. The specimens received from Mr. Merrill are, like the Hebbville, Md., rock, composed entirely of bronzite and a light emerald green monoclinic pyroxene, but they are more acid and richer in mag-an their Maryland equivalents, as may be seen from wing analysis (VIII) by E. A. Schneider of the U. S. al Survey.

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[5] See also the analysis by Player of a chrome diopside from the Lizard gabbros, published by Teall, Miner. Mag. VIII, p. 116, 1888.

[6] Annual Report of the Geological Survey of Pennsylvania for 1887, p. 95. 1889.

VIII.

SiO_2	55.14
Al_2O_3	0.66
Cr_2O_3	0.25
Fe_2O_3	3.48
FeO	4.73
MnO	0.03
CaO	8.39
MgO	26.66
Na_2O	0.30
H_2O	0.38
P_2O_5	0.23
Total	100.25

ase of this rock is a saccharoidal and easily pulveregate of brilliant green diopside grains, through which ibuted large and somewhat rounded crystals of a pale ronzite, whose diameter is from one to three millimehe relative amount of bronzite is quite variable, even ame hand specimens, as it shows a tendency to con-

Other plutonic rocks containing neither feldspar nor olivine, which may therefore be properly classed as pyroxenites although they do not belong to either of the two types here described from Maryland, have been mentioned by Hunt[8] from Rougemont and Montarville, Canada, and by Dana[9] and the writer[10] from near Peekskill on the Hudson. Similar masses composed of intensely pleochroic rhombic pyroxene (amblystegite), hornblende and biotite were found by Teall[11] in the Hebredean gneiss of northern Scotland, while Hatch[12] reports hypersthene-diallage rocks from Madagascar. Prof. F. W. Hutton[13] in his recent paper on the Eruptive rocks of New Zealand describes as pyroxenites an enstatite-diallage rock forming a dike in the serpentine of the Dun mountain; a hornblende-biotite rock from Dusky sound and a chlorite biotite rock from Martin's bay.

On the use of the name Pyroxenite. The undoubledly wide distribution of igneous rocks free from both feldspar and olivine, suggests the necessity of establishing a class designation, coordinate with the name *Peridotite* given by Rosenbusch to the corresponding olivine-bearing series, and, like this, capable of subdivision into types. For such generic use the term, *Pyroxenite*, is in all respects the most desirable, although it has already been employed as a petrographical name in at least four distinct senses. It is my hope to be able to show that its use as a designation for any rocks except those of igneous origin which are devoid of any feldspathic or olivine constituents should be abandoned.

The name pyroxenite was first used by Dr. T. Sterry Hunt,[14] who applied it both to intrusive rocks composed mostly of pyroxene, like those of Rougemont and Montarville, and to the more or less massive beds or nests of pyroxene so often

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[7] Serpentine which appear to have originated from pure pyroxene rocks have also been described by Drasche from Carinthia, Tyrol and from Ireland (Tschm. Min. Mitth., I, 10, 1871); by Berwerth from Italy (ib. IV, 238, 1876); by Becke from Greece (Tschm. Min.Petr.Mitth., I,461, 1878); by Eichstädt from Sweden (Geol. Fören. Förh., VII, p. 333, 1884); and by Rosenbusch from Baden (Massige Gest., 2d Ed., p. 276, 1885).

[8] Geology of Canada, p. 667, 1873.

[9] Am. Jour. Science, (III), vol. 20 p. 199.

[10] Am. Jour. Science, (III), vol. 33, p. 194, March, 1887.

[11] British Petrography, pp. 71 and 84, 1888.

[12] Quart. Jour. Geol. Soc., vol. 44, p. 345, May, 1889.

[13] Roy. Soc., New South Wales, p. 153, Aug. 7, 1889.

[14] Geology of Canada, 1863, p. 667.

ted in the Archean limestones of New York and Cana-
tween these two groups, genetically so distinct, no
ie has ever been drawn. In their text-books, Kal-
and J. D. Dana[17] designate as pyroxenite any rock
d wholly or largely of pyroxene, without regard to its

g the Canadian geologists the term has gradually
stand almost altogether for the pyroxenic nests or
rystalline limestone which contain a great variety of
nerals,[18] and have genetically no connection with the
d pyroxene rocks.

g French authors the use of the term pyroxenite, is
ite different and includes members of the crystalline
hich are not wholly or even principally composed of
. Thus de Lapparent says: "Les Pyroxénites sont
es de plagioclase et de pyroxène, qui forment des
le quelques centimètres jusqu 'à plusieurs mètres régu-
t interstratifiées dans les gneiss."[19] In his recent
paper on the "Pyroxenites of the Islands of Morbi-

some secondary oligoclase, occurring as a member of the crystalline series near Saint Nazaire, France.[22]

Rocks of this kind would be called by German and English petrographers, *augite gneiss*, and it is a pleasure to see that in his most recent work on rocks of this kind, Lacroix has conformed to this usage.[23]

Finally the name pyroxenite has been temporally employed in still a fourth sense to indicate certain recent volcanic rocks. Zujovics(or Jouyovitch)[24] and Doelter[25] both proposed to use it in this way; but they subsequently substituted *augitite* for it upon discovering the many senses in which *pyroxenite* had already been employed.[26]

If the Canadian use of the name pyroxenite for aggregated nests in crystalline limestone be abandoned, as the French employment of the same term for augite gneiss, and the German use for certain basic volcanic rocks practically have been, we shall then have two parallel series of non-feldspathic plutonic rocks, the one free from and the other containing olivine, which may be further subdivided as follows:—

GROUP OF THE NON-FELDSPATHIC MASSIVE ROCKS.

I. PLUTONIC.

Olivine-bearing. PERIDOTITE (Rosenbusch, 1877)		*Olivine-free.* PYROXENITE (Hunt, 1862.)
1. Picrite, (Tschermak, 1866)	augite.	
2. Wehrlite, (v. Kobell, 1838)	diallage.	Diallagite.
3. Saxonite, (Wadsworth, 1884) Harzburgite, (Rosenbusch, '85)	enstatite.	Bronzitite. Hypersthenite.
4. Buchnerite, (Wadsworth, 1884)	enstatite & augite.	
5. Lherzolite, (de la Metherie.)	enstatite & diallage	Websterite, (Williams, 1890)
6. Hornblende-Picrite, (Bonney, 1881) (Cortlandtite)	hornblende & augite.	Hornblendite, (Dana, 1880)
7. Scyelite, (Judd, 1885)	hornblende & mica.	Teall's north of Scotland rocks(?)
8. Dunite, (v. Hochstetter, 1859)	chromite.	Hutton's New Zealand rock.

II. VOLCANIC.

Limburgite, (Rosenbusch, 1872) Magma-basalt, (Boricky, 1873)		Augitite, (Doelter, 1882)

Gradation of the Maryland Pyroxenites into other Rock types. The bronzite-diallage rocks, which form the types of pyroxenite prevalent in Maryland, can be traced by insensible grada-

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[22] Bull. de la Soc. Fr. de Minéralogie, vol. x, p. 288, 1887.

[23] Ib. vol. xii, p. 83, 1889.

[24] Note sur les roches éruptives et métamorphiques des Andes. Belgrade, 1880.

[25] Ueber Pyroxenite, ein neues basaltisches Gestein. Verh. k. k. geol. Reichsanstalt, 1882, p. 140, and Die Vulkane der Cap Verden, p. 137, 1882.

[26] Les roches des Cordillères, Paris, 1884, p. 38-39.
cf. also Rosenbusch: Mass. Gest. 2d Ed. p. 813, 1885.

ed in the Archean limestones of New York and Cana-
ween these two groups, genetically so distinct, no
ne has ever been drawn. In their text-books, Kal-
and J. D. Dana[17] designate as pyroxenite any rock
ed wholly or largely of pyroxene, without regard to its

ng the Canadian geologists the term has gradually
to stand almost altogether for the pyroxenic nests or
n crystalline limestone which contain a great variety of
minerals,[18] and have genetically no connection with the
land pyroxene rocks.

mong French authors the use of the term pyroxenite, is
in quite different and includes members of the crystalline
ists which are not wholly or even principally composed of
roxene. Thus de Lapparent says: "Les Pyroxénites sont
es roches de plagioclase et de pyroxène, qui forment des
ouches de quelques centimètres jusqu 'à plusieurs mètres régu-
ièrement interstratifiées dans les gneiss."[19] In his recent
valuable paper on the "Pyroxenites of the Islands of Morbi-
han,"[20] Prof. Ch. Barrois describes beds of gneissic rock con-
ides malacolite and diallage, quartz, feldspar, garnet,
rutile, apatite, etc. These alternate
and are regarded by the
beds of

represents the variously differentiated facies of a single magma. Such a magma probably continued to furnish, through a long period, eruptive material, while it was itself undergoing local changes in chemical constitution; or else successive eruptions occurred from a magma which was itself never chemically homogeneous. Such a union of several petrographical types into a geological unit mass is the rule rather than the exception in eruptive areas. It is illustrated in even greater variety in the "Cortlandt Series," near Pekskill, N. Y.,[27] where, as in the neighborhood of Baltimore, certain well-marked types prevail, which are connected by every conceivable intermediate form.

In a later paper the writer hopes to trace out chemically and microscopically the course of alteration whereby the Maryland pyroxenites are transformed into serpentinous, hornblendic and steatitic masses.

Petrographical Laboratory of the Johns Hopkins University,
Baltimore, April, 1890.

ICE CLIFFS ON KOWAK RIVER, ALASKA, OBSERVED BY LIEUT. CANTWELL.

By Israel C. Russell.
U. S. Geological Survey, Washington, D. C.

In a recent report of a cruise of the U. S. Revenue Marine steamer "Corwin,"[1] there is an interesting narrative by Lieut. John C. Cantwell, of a boat journey up the Kowak river, Alaska. In this narrative there is a brief account of remarkable ice cliffs forming the river's bank, of the same general character as the ice cliffs at Elephant point, on Eschscholtz bay, several accounts of which have been published.[2] Four rock. The character of the surface of this plateau is d by Lieut. Cantwell as follows:[3]

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[27] Am. Jour. Science, (III) vol. 35, p. 447, June, 1888.

[1] Report of the cruise of the Revenue Marine-steamer "Corwin" in the Arctic Ocean in the year 1885. By Capt. M. A. Healy, U. S. R. M. Commander. Washington, 1887, 49th Congress, 1st Session, House of Representatives, Ex. Doc. No. 153, 4to, pp. 1-102, 2 maps and 42 plates.

[2] Descriptions of this locality may be found in the following books:

Otto von Kotzebue: A voyage of discovery into the South sea and Behring's straits, for the purpose of exploring a northeast passage. Undertaken in the years 1815-1818. London, 1821, 8vo, vol. I, pp. 219-220. (See next page.)

"Climbing to the top of one of these ice-cliffs, Mr. Tc and I pushed our way through the dense thickets of and luxuriant growth of grass into the interior for ab mile, where we found a shallow lake about a mile in di and which I have no doubt had its origin in the mas over which we had been traveling. It is almost incon how such a rank vegetation can be sustained under s ditions. If we stood in one place any length of time, the moss became saturated, and soon a pool of dark-colore made our position untenable. Besides the moss, berr stunted willows, clusters of spruce trees, some measurir 8 inches in diameter, have taken root and grown in strata of soil overlying the ice."

Being anxious to obtain a more detailed description interesting deposit, I addressed a letter to Lieut. Cant dicating the facts would be of geological interest, a favored with the reply given below. This informati requested for publication in a paper on the surface ge Alaska, but owing to delay in the mails, it did not a time to be used in that connection, and is here publi order that the interesting observations it contains r be lost.

Captain Beechey: A narrative of the voyage and travels of Beechey, R. N., F. R. S., &c., to the Pacific and Behring's performed in the years 1825, '26, '27 and '28. London, 8vo, pp.

W. H. Dall: Extract from a report to C. P. Patterson, [O Survey work in Alaska.] Am. Jour. Sci., 3rd ser., vol. 21,

U. S. REVENUE MARINE STEAMER CORWIN.

Astoria, Oregon, March 28th, 1890.

Sir:—During the summer of 1884, I was detailed by captain M. A. Healy, Com'g the U. S. steamer "Corwin," to take charge of a small party sent out from that vessel for the purpose of exploring the Kowak river, a stream which had hitherto been unknown, except through native reports and from superficial examinations of its mouth by occasional visiting ships. The river takes its rise in a system of lakes situated in the northwest part of Alaska, flows in a westerly direction and empties into Hotham inlet which is an arm of the Kotzebue sound. Its course throughout is within the Arctic circle and is very tortuous in the vicinity of its delta. The river is navigable for a distance of about 375 miles. Beyond this point the channel is obstructed by rapids and contracted by many small islands and gravel beds. At two points before reaching the head-waters of the stream, we encountered gorges where the width of the stream scarcely exceeds twenty yards and where the channel was filled with rough bowlders. The current at these points was so strong that we were compelled to portage our small boats.

Some seventy or eighty miles from the mouth of the river is where we first observed the ice-cliffs mentioned in my official report. At this point the cliffs were from 125 to 150 feet high, gradually decreasing in hight as we noted their recurrence on our way up stream, until they had entirely disappeared when we had reached the foot-hills of the first chain of mountains through which the river flows. The topography of the Kowak valley in the vicinity of the ice-cliffs is characterized by undulating tundra plains, varied by patches of small spruce timber which, as a general rule, was most abundant along the banks of the stream. The most remarkable example of this curious formation is the first series of ice-cliffs seen on the journey up stream. Here, as before stated, the cliffs are not less than 125 feet high and abut directly on the river. For about a mile, there is exposed to view a solid mass of ice, superposed by a layer of soft earth forming a uniform thickness of about six feet. The surface of the soil is covered by a dense growth of moss and sphagnum. The timber growing over the ice is as heavy as that found anywhere else in the vicinity, being from four to eight inches in diameter and from twenty to forty feet high. The exposed face of the cliff is broken into a thousand fantastic shapes by the combined action of sun and rain, and the lower portion is hollowed out and curved by the constant erosion of the stream.

In color, the cliffs are dark brown, varied by grayish spots where pieces of ice have recently been detached. The ice is not clear, and must have been formed from water holding in

a large quantity of earthy matter. There is no appa-
tification. A small piece which I obtained and melted
a residum composed largely of fine dust, moss and
nizable vegetable matter. No gravel was seen either
mens examined or anywhere along the base of the
he shore line in front of the cliffs was marked by an
ation of soft, almost impalpable dust, piled in heaps
t of fifteen or twenty feet. The dust piles were evi-
he result of the melting of the ice during the summer
as the annual spring freshets caused by the melting
the mountains sweep everything movable before them.
rst impression was that the ice-cliffs were formed by
brought down by the river and forced into the soft
further observations caused me to reject this theory
able. In the first place, the ice is solid, without crease
re from top to bottom; and, again, there are numer-
sand and clay cliffs abutting on the river in situations
similar with reference to the current to those occupied
ice-cliffs, in which not a particle of ice is to be seen.
e ice-cliffs are located on the left or south bank of the
d appear and disappear as the course of the stream
es or recedes from an imaginary straight line joining

of the Ice age in France and Switzerland, the action of ice in erosion, transportation, deposition, and the causes of this unique geologic period. Apparently at the same time with the accumulation of the great ice-sheet of northwestern Europe, deep and broad ice-streams poured downward from the Alps to the vicinity of Strasbourg on the north and to Lyons on the west; while the Pyrenees, the mountains of Auvergne, of the Morvan, and the Vosges, nourished glaciers similar to those which remain in the Alps at the present day. The traces of the ancient glaciation of these districts, their moraines and other glacial and alluvial deposits, the loess, and especially notable erratic blocks or boulders, are interestingly described, with numerous illustrations from photographs. For the greater part of France the glacial period was characterized by abundant rainfall with no permanent accumulations of snow and ice; the fauna included the mammoth and reindeer and with them primitive man is known to have been a witness of the climatic vicissitudes of the growth, culmination, and departure of the vast Quaternary glaciers, but the author believes that no proofs of greater antiquity of our race have yet been discovered.

Much attention is given to the progress and changes in opinions in explanation of the facts observed, from the times of DeSaussure, Elie de Beaumont, Playfair, Charpentier, and Agassiz, to the present general assent accorded to the theory of land-ice as the drift-forming agency, first understood in the Alps and thence extended to explain the drift of continental areas. The deep lakes bordering the Alps are attributed to orographic movements, but glacial erosion has produced small mountain tarns. Fjords, however, seem to have been channelled by streams before the Ice age, instead of being orogenic fractures, as they are regarded by this author. After noticing Boucheporn's suggestion of displacement of the earth's axis as the cause of glaciation in what are now temperate latitudes, and Dr. Croll's theory of its dependence on eccentricity of the earth's orbit, both of which are thought to lack sufficient support, M. Falsan concludes that an elevation of the mountains above their present hight was the chief element inducing the formation of the great Quaternary glaciers; and from his study in the Rhone basin he finds evidence of only one glacial epoch, but this included various phases of retreat and re-advance of the ice, by which stratified and sometimes fossiliferous beds came to be intercalated between unstratified formations of glacial origin.

Nearly the same opinions on the cause and the unity of this period are held by Prof. G. F. Wright in his work on "The Ice Age in North America," which was published almost simultaneously with this volume. But if there were in some regions two distinct glacial epochs, separated by a long interval of warm or temperate climate, as many geologists believe to be proved for other alpine districts, for Great Britan, Bavaria, and North America, the repetition of ice-accumulations is ascribed by M. Falsan to repeated uplifts of the land, which, as suggested also by Upham, were not probably synchronous for all

ountries. What the elaborate treatises of Geikie, Falsan,
t have done for the Ice age in Scotland, France, and the
ates, it now becomes very desirable that others should sup-
ilar form, attractive to ordinary readers, for its extensive
important records in Germany, Scandinavia, and Canada.
isiting the French side of the Alps or Pyreenes should not
ad M. Falsan's book, a duodecimo of the "Bibliothèque
e Internationale;" and it will be found a most valuable
for glacialists everywhere.

ry *History of Mono Valley, California.* By ISRAEL C. RUSS-
es 261-394; plates XVI—XLIV; and 12 figures in the text. (Ac-
g the eighth annual report of the director of the U. S. Geo-
vey.)

ler is very agreeably introduced to the district described in this
d becomes acquainted with its principal topographic features
t climatic and physical conditions as a section of the arid
esert regions of the Great Basin, bounded on the west by the
a, and learns the outlines of its geologic structure and his-
crossing the Mono basin in an imaginary ride with the author
lorations and ascending with him to the summit of Mt. Dana
ra water-shed, eight miles distant from lake Mono, above

the lake. It is shown that the formation of the crags and columnar trunks the latter sometimes resembling a forest of gnarled trunks and stumps changed to stone, commenced with the deposition of porous and tubular lithoid tufa from the waters of sub-lacustral springs, and that the cones and tubular masses thus formed were subsequently enveloped in sheathings of the dendritic, thinolitic, and lithoid varieties, precipitated from the lake waters. Careful investigation, however, has not yet determined "why at one time the tufa should have a beautifully dendritic structure, at another time form regular and symmetric crystals, and still again be a structureless stony mass, each deposit having the same composition and being evidently formed from the same solution."

Glaciers of great extent covered the Sierra Nevada excepting its highest sharp peaks and ridges, and flowed down the lateral canons heaping great morainal embankments along their sides and on the broad lower slopes, terminating below the highest Mono beach. Their maximum extension preceded the highest level of the lake, which probably marked a time of rapid melting of the snow and ice on the mountains. There were at least two epochs of glacial extension, besides many minor fluctuations; and what may be termed an interglacial epoch is recorded in the sediments of the ancient lake by an accumulation of gravel separating two heavy deposits of lacustral sediments.

Volcanic action has been displayed on a grand scale in the Mono basin since the high water stage of the lake which followed the maximum extension of the Sierra Nevada glaciers. Some of these points of recent eruption are situated on the islands of the lake, others lie beneath its surface, and still others are found on the southern portion of the basin, where they form part of a range of volcanic cones known as the Mono Craters, which in greater part, however, seems to be of earlier Quaternary age. Beginning less than a mile from the shore of the lake, the Mono Craters extend in a crescentic belt to the southeast and south about eight miles, rising 630 to 2,750 feet above the lake level. All the cones of the range are largely built of lapilli, which have a light gray tint and form smooth, even slopes about the vents from which they were ejected. Interbedded with these accumulations of volcanic rock fragments are thick sheets of black obsidian that flowed in various directions from vents, usually near the crest of the range.

"Owing to the viscid character of the lava at the time of its extrusion, it formed thick sheets which terminated on their lower margins in precipices two or three hundred feet high. The contrast here presented by esentially the same rock under different conditions of extrusion can scarcely be surpassed. The lapilli are loose, vesicular, incoherent, and light-colored, and form smooth, curved slopes of great regularity and beauty; the obsidian is compact, dense, black in color, massive in appearance, and the surface is broken into huge angular blocks thrown together in the utmost confusion.

Reviewing the climatic changes indicated by lakes Mono, Lahontan,

ille, the author concludes that the early Quaternary was
nued period of aridity, and that this was followed by a time
great but not excessive humidity, during which a large
he enclosed basins of the region became flooded, though
m were not raised so high as to overflow. Then followed
istral epoch of low water, doubtless coinciding with the
terglacial epoch, when many, if not all, of these basins
etely desiccated. A second maximum of lake extension
s arid epoch and was succeeded by another era of desicca-
intensity, during which and probably not more than three
rs ago the lakes of the Lahontan basin were evaporated to
ecently a gradual change to a more humid climate brought
nditions now characteristic of the arid regions of the West;
ssell thinks that this latest change has not yet culminated,
reased humidity in the Great Basin may be expected in

Devonian plants from Scotland. By SIR J. WM. DAWSON.
ril 10, 1890.)
nunication enumerates several species of fossil plants from
nd Caithness, Scotland. The most abundant species is
princeps Dn. and then *P. robustius* Dn. and *Arthrostigma*

Scott protests with apparently very good reasons. A lengthy discussion of 17 pages is given to *Protoreodon* S & O. In part iii, Prof. Osborn describes the utter confusion brought about by the useless attempts to describe and work from brief descriptions without the aid of plates or cuts. Upon investigation he has found the perissodactyla of this formation considerably mixed up, and it seems proper at this point to call attention to the necessity of ignoring to a certain extent brief descriptions unless accompanied by plates or some other method of illustration. The family *Amyodontidæ* is discussed and a new species *A. intermedium* described and illustrated; *Diplacodon, Isectolophus, Triplopus* and *Epihippus* complete the part. The memoir is then concluded with an interesting paper by Prof. Osborn on "The Evolution of the Ungulate Foot," and some extremely interesting material is brought forward. Like all the papers from the Princeton Museum this exhibits the usual great care with which their subjects are treated. It is illustrated by well executed plates.

RECENT PUBLICATIONS.

1. *State and Government Reports.*

California state Mining Bureau. Wm. Irelan, Jr., state mineralogist. Ninth annual report, for the year 1889. 352 pp., octavo. Numerous half-tone plates, and other illustrations. Sacramento.

Geological Survey of Texas. E. T. Dumble, state geologist. A preliminary annotated check-list of the Cretaceous invertebrate fossils of Texas. Bulletin No. 4. Robert T. Hill. 57 pp., 8vo.

Geological Survey of Missouri. Arthur Winslow, state geologist. Bulletin No. 1 contains: Administrative report, Arthur Winslow; The coal beds of Lafayette county, Arthur Winslow; The building stones and clays of Iron, St. Francois and Madison counties, G. E. Ladd; The mineral waters of Saline county, A. E. Woodward; A preliminary catalogue of the fossils occurring in Missouri, E. Hambach.

Revision of the genus Araucarioxylon of Kraus, with compiled descriptions and partial synonymy of the species. F. H. Knowlton. U. S. Nat. Mus., vol XII, pp. 601-617.

Notes on the serpentinous rocks of Essex county, N. Y.; from Aqueduct shaft 26, New York city, and from near Easton, Pa. Geo. P. Merrill. U. S. Nat. Mus., vol. XII, pp. 595-600.

Report of the U. S. Geographical Surveys west of the 100th meridian, in charge of Capt. Geo. M. Wheeler, vol. I, Geographical report. Washington, 1889. Quarto, pp. 780, 38 plates, 3 maps.

2. *Proceedings of Scientific Societies.*

The Journal Cin. Soc. Nat. Hist., April, 1890, contains: Description of some new genera and species of echinodermata from the Coal Measub-carboniferous rocks of Indiana, Missouri and Iowa, S. A. Wm. F. E. Gurley; Description of a new species of gigantic rodent (Castoroides georgiensis), Joseph Moore; A cave ton formation in Ohio, Jos. F. James.

logical Society of America has issued the following portions its Bulletin: The value of the term "Hudson River group" al nomenclature, C. D. Walcott; Some results of Archean exander Winchell; Post-Tertiary deposits of Manitoba, J. ; Sandstone dikes, J. S. Diller; Tertiary and Cretaceous eastern Massachusetts, N. S. Shaler; The stratigraphy of ec group," R. W. Ells; Some additional evidences bearing erval between the glacial epochs, T. C. Chamberlin; The one and its fauna, a discussion of methods of correlation, H. s; The Calciferous formation in the Champlain valley, nd Seely, with a supplement on the Fort Cassin rocks and s, by R. P. Whitfield; Proceedings of the annual meeting v York, Dec. 26, 27 and 28, 1889, containing liberal abstracts y Newberry (The Laramie group); Geo. H. Williams (Erup- tines at Syracuse, N. Y.); Clark (Tertiary deposits of the river region); McConnell (Glacial features of the Yukon enzie basins); Wright (Moraine of recession in Ontario); pomattox formation); Geo. H. Williams (Petrographic ob-

6. *Scientific Laboratories and Museums.*

Third annual geological expedition into southern Maryland and Virginia. Wm. B. Clark. (From Johns Hopkins University Circulars, No. 81).

On the Cheyenne sandstone and the Neocomian Shales of Kansas. F. W. Cragin. (Bul. Wash. Col. Lab. vol. 2, No. 2).

On some occurrences of Ottrelite and ilmenite schist in New England. J. E. Wolff. (Bul. Mus. Comp. Zool. Geol. Ser., vol. 2).

CORRESPONDENCE.

Some Further Corrections of "North American Geology and Palæontology."

In accordance with a suggestion in your correspondence of April I send some further corrections of the above work, relating to the Rugose Corals. The lists of species in this group give evidence of thorough and careful research and form a valuable addition to the library and laboratory. The generic descriptions, however, are rather too brief to be of much working value to one not already acquainted with their characteristics. What is sadly needed in this branch of palæontology is a thorough working over of the genera similar to that begun by Messrs Thompson and Nicholson and published some fifteen years ago. In addition to their brevity some of the generic descriptions are misleading and a few entirely incorrect.

In the American species of Acervularia the position of the inner wall is generally *indicated* merely by a thickening of the septa about the central pit. A clintonensis, however, is described by Nicholson as having a distinct wall such as is found in a few of the European species of this genus. The septa generally are well developed though seldom reaching the center.

Craspedophyllum is not a synonym for Heliophyllum. It was founded by Dybowski, in 1873, upon a specimen of Diphyphyllum archiaci Billings, from Columbus, Ohio; in a small pamphlet entitled, "Beschreibung einer neuen, aus Nordamerika stammenden, Devonischen Art der Loantharia Rugosa," St. Petersburg. The description was not inserted in his "Monographie" published the same year but the genus was included in the classification and gave its name to the family including also Heliophyllum E. & H. and Acanthophyllum Dyb. Craspedophyllum is characterized (p. 10) by the narrow central, tabulate area separated from the broad, outer area by a heavy wall and the presence of carinæ in the outer peripheral region. The Annals and Magazine of Natural History for Jan. 1878, (5th ser. vol. I, p. 44 etc.) contains an article by Prof. Nicholson "On the minute structure of the corals of the Geneva Heliophyllum and Crepidophyllum." To this is subjoined the following foot-note, "Descriptions of

ers of Heliophyllum and Crepidophyllum formed part of a
Ir. James Thompson and myself, which was laid before the
ty of Edinburgh in the session of 1875-76, and an abstract
s published in the 'Proceedings,' vol. IX, No. 95, p. 149."
genus was founded upon some specimens from the Devon-
da, formerly referred by Nicholson to Heliophyllum (sub-
), and is identical with Craspedophyllum, which upon the
ble consideration preceded it by two years. In the article
red to Nicholson states (p. 49) "By Dybowski (Mon. der
r. rug. aus der silur. formation, etc., p. 83) the genus
m is placed in a special family Craspedophyllidæ along
w genera Acanthophyllum and Craspedophyllum, the only
ssigned to the family being that there is no accessory wall,
ta are complete, and that the sides of the septa are sup-
ateral outgrowths." The portion of the classification of
eferred to is here given.

6. **Family** Craspedophyllidæ.

No accessory wall. Septa completely developed.

a Side faces of the septa supplied with
lateral outgrowths.
Genus, Heliophyllum E. & H.

b Side faces of the septa supplied with perfoliatum. Conceived thus in error the genus has seemed ill-fated throughout its history. The original description must be considered largely responsible and this has unfortunately been given a new lease of life in Mr. Miller's work. The writer has in preparation a paper on this genus in which he hopes to make clearer its internal structure; it is sufficient to state here that it is not made up of a series of invaginated cells, has no tabulæ, the septa are not generally equally developed, it has or *had* a wall and possesses a complete vesicular structure.

Of the American species magnificum and ponderosum may be stated certainly to belong to this genus. Belli and vadum are doubtful in regard to their generic relations and must be compared with type structures before they can positively be accepted. An examination of numerous specimens of ellipticum has proven conclusively that they do not belong here; their coarse, vesicular tissue and tabulæ give them structural relationship with Cyathophyllum houghtoni Rominger, as pointed out by this author. (Geol. Sur. of Mich. vol. III, pt. II, p. 105). Capax, with its concentric wrinkles and radiciform processes, deep fovea, and false columella, is removed with equal certainty from Chonophyllum, and sedaliense has nothing in its description or figure to suggest this genus. C. *validum* Hall must be an error of the compiler. Its references belong to C. vadum Hall.

Conophyllum Hall has not the relationship to the above genus that its name would seem to imply, or which Prof. Hall later supposed that it possessed. Its type species, C. niagarense Hall, has been correctly determined by Dr. Rominger to be a Cystiphyllum. (Geol. Sur. of Mich. vol. III, pt. II, p. 138) The frequent rudimentary condition of the septa and the invaginated, blistered cells, shown in specimens from N. Y., Mich., Ind., and Iowa all attest the correctness of this judgment, It is especially unfortunate that Mr. Miller has figured this alone with which to represent Chonophyllum.

There are a number of less important corrections that may be noted before closing;—Zaphrentis cornicula is a well pronounced Heliophyllum; Ptychophyllum should be credited simply to Edwards and Haime; Syringopora? multicaulis Hall is shown by its well developed septa to be a Diphyphyllum—(See Geol. Sur. of Mich. vol. III, pt. II, p. 122) and Cyathophyllum helianthoides Goldf. is not synonymous with Heliophyllum halli E. & H. Specimens of the former from the Eifel show carinæ in places but they are specially distinct from the latter.

WILL H. SHERZER.

Geol. Laboratory, University of Michigan, April 15, 1890.

MILLER'S NORTH AMERICAN GEOLOGY AND PALEONTOLOGY.—I would ask space in your journal for a plain statement of that which is in part personal to myself and in part relates to the work which I recently published under the name of the "North American Geology and Palæontology." Messrs. Dulau & Co. of London, England, ordered several copies of the book, and I took the liberty of sending an extra copy to that book-concern to be delivered to the *Annals and Magazine of Natur-*

of London, for review. In the April number of that journal
ared a false, malicious and libellous article, under cover of
f the work. The journal was not sent to me, but I accidental-
article and at once wrote a letter to the Annals and Magazine
History, in care of Dulau & Co., who had delivered the book,
er was returned to me with a refusal to publish it. I do not
expose the cowardice of the anonymous libeller, or to make
sms upon the disingenuous management of the Annals and
of Natural History, or its superviency to those nearest
I ask you to publish the letter I sent to that journal and ap-
o, and on another occasion I will make known the motives
ed the unwarranted attack, as I recognize the author as well
et tracks, as I would if his signature had appeared with the
me at full length as usual.

ti, O., May 24th, 1890. S. A. MILLER.

CINCINNATTI, OHIO, Apr. 28, 1890.

nnals and Magazine of Natural History, London, England:—
il number of your journal, containing a review (?) of my
orth American Geology and Palæontology fell into my hands
the Public Library of this city. I think the reviewer, instead
itical, has been intemperate and spiteful, and, though neith-

lurian Gastropoda made the genus *Onychochilus* and the species *O. cochleatum* and *O. reticulatum*. Prof. Whiteaves, in 1884, made *Codonocheilus* and *C. striatum*. Prof. Hall, in 1885, made *Prorhynchus*, *P. angulatum*, *P. nasutum* and *P. quadratum*. Prof. Whitfield, in 1882, made *Streptorhynchus cardinale*, and in the Annual Rep. Geo. Sur. Wis. for 1877, page 50, he made *Palæophycus plumosum*. If this reviewer is correct, Lindstrom, Whiteaves, Hall, Whitfield and many others whom I might name are "illiterate amateurs," whose knowledge of Latin is not above the barking of a dog. It happens, however, they are distinguished naturalists, and some of them are distinguished linguists, and they have all conformed to the laws of language and the laws of nomenclature in the use of these words, for the rule is, the Greek word takes on *only* the form of the Latin language and retains the gender and meaning which belong to it. I have followed the laws of nomenclature, and the practice of all scientific men of this country, and so far as I am advised the learned naturalists of other countries.

I have before me Andrews' Latin Lexicon, published by Harper Brothers, New York, 1872. On page 46, "*aegilops*" is defined as "*A kind of oak with edible fruit* (*acorns*), *Quercus aegilops*," and the palæontologist who used the name for a species did so because his fossil was like an acorn. On page 170, "*aucella*" is defined as "*A litle bird*," and no other definition is given, and it was used by the palæontologist, from a fancied resemblance of his fossil to a small bird. On page 195, "*bellulus*" is defined as "*pretty, elegant, lovely, beautiful*," and the name has been used in American palæontology only in the sense of "*very pretty*." On page 261, "*cerasus*" is defined as "*a cherry*," and the palæontologist used the name "*cerasiformis*" because he thought his fossil was "*like a dried cherry*." On page 811, "*insectus*" is defined as "*non sectus*," and the word when applied to a fossil has been used in the sense of "*uncut*." On page 1523, "*temerarius*" is defined as "*accidental, casual*," and it is only in that sense the word is used in palæontology. On page 1652 of Liddell and Scott's Greek-English Lexicon, published in 1872 by Harper Brothers, New York, one of the definitions of "*cheilos*" is "*the edge*," and the palæontologist who used "*dikrocheilus*" used it in the sense of "*two edged*" or "*having two edges*." "*Mummiform*" is defined in Webster's Unabridged Dictionary, as "*resembling a mummy*," and "*mumiformis*" has been used as a specific name for a black, carbonaceous fossil which the author fancied "*resembled a mummy*."

A glossary is defined by Webster as "*A collection of glosses or explanations of the special meanings and difficult terms of a work*," and so far as I am able to discover the correct special meaning of each of the above words is given in my glossary. But your reviewer may say I have not accounted for all the errors he has found, that make him "*sorry for the amateurs*." Well, he has found some typographical errors that would be patent to the merest beginner, for instance, "*altilis*" means "*fattened*," and the types have made it mean "*flatten-*

vadosus" means "*full of shallows,*" and the printer read the
n the manuscript for a "*d*" and thus printed "*shadows*" in-
hallows." In this country, a pretended critic guilty of laying
n a transparent typographical error would be regarded as
mind too "*shallow*" to entitle him to any consideration.
t "*Turrilepas*" not "*turrilepas?*" On page 257 of my work,
Lepas" is defined. On page 569, an accidental mistake of
of the printer exists, for the word is correctly defined, in
n of my Catalogue of Palæozoic Fossils, in 1877, and the
f the word has been well known to me as well as the fossils
e name for twenty years. How about "*Leperditia?*" There
istake and the only one mentioned by the reviewer worthy
ation. I never saw the memoir of Rouault, and never heard
name, Leperdit, until since the publication of my work,
. Lindstrom, recognizing the difficulty of finding the special
f some technical names, very kindly gave me the informa-
tter.

ewer, however, reaches, the climax of his spite or ignorance,
ng paragraph, when he says, "*Above all, gracilius, a, um,*
m, and minus, a, um, the neuter comparative forms of gracil-
s and parvus. Had he given us also, plus, pla, plum, he would

The first time the name was used in geology with the signification attached to it by its originator, is at p. 18, *A geological map of the United States and the British Provinces of North America*, by Jules Marcou, Boston, July, 1853, where we read: "System of mountains, which I shall call, after the example of the author of the *History of Canada*, Mr. F.X. Garneau, the *Lawrentine Mountains*," and at p. 67 "*Lawrentine system*—The granitic, syenitic and gneiss rocks, which make the foundation of the Lawrentine Mountains."

Logan, one year and a half after the publication of my volume, in his *Report of Progress for the year 1852-3*, Quebec, 1854, but not issued until April, 1855, speaks at p. 7 of "the metamorphic hills to which Mr. Garneau in his History of Canada has given the name of the Laurentides"; and in the following page he uses the name of *Laurentian series*, directly below the Potsdam sandstone, without a single rock between them, suppressing the 25 or 30,000 feet of strata found and described by Dr. Emmons, under the name of Taconic system.

From these data and quotations, it is very clear that the proposition of my good friend Francois Xavier Garneau was unknown to all geologists, until I pointed it out in July, 1853.

On the 20th of November, 1850, Desor proposed, before the Boston Society of Natural History, to name some Quaternary marine shell deposits the *Laurentian*, and the 19th of May, 1851, he gave more force to his proposition in publishing a paper with a section in the *Bulletin of the Geological Society of France*, vol. VIII, pp. 420-423. He distinguished two terrains and called the marine shell deposits *Laurentian* or *terrain Laurentien*, because it is especially well developed in the basin of the St. Lawrence river. Logan in using Laurentian in 1855 for masses of crystalline rocks duplicated the name, and acted against the right of priority; notwithstanding his explanation that he took the name from the mountain chain of the Laurentides, and not from the valley of the St. Lawrence river.

Champlain as a designation of the Quaternary clay of the same region and as a synonym of Laurentian is even more against all right of priority and against all sound principles of nomenclature. As far back as 1842, Dr. Emmons, the founder of the Lower Palæozoic classification and nomenclature, proposed the name *Champlain* to designate all the strata containing the second fauna, and the name of *Champlain group* or *Champlain system* has been used constantly ever since by almost all geologists, the Geological Survey of Canada included. The idea of proposing for the second fauna group of strata the name *Ordovician* as late as 1879, and to use it in America instead of Champlain is a rare example of passing over all right of priority, and of substituting fancy and caprice for rules used in natural history. But the return and enforcement of right of priority in geological nomenclature and classification is certain one day or another, and the sooner the better, for there is actually a tendency to increase geographical names at such a rate, and confusion has already taken such proportions, that the constant xplanation will force a return to the rules used in zoology

JULES MARCOU.

Mass., April, 1890.

RVATIONS ON NATURAL CASTS OF CRINOIDS AND BLASTOIDS
RLINGTON LIMESTONE. The Sub-carboniferous series of rocks
ssippi valley is a perfect storehouse of fossil Echinoderms,
e is the naturalist whose "lot has been cast" near such
ting ground as Burlington, Keokuk or LeGrande, Iowa;
le or Bono, Indiana.; Chester or Warsaw, Ill.; Cowan,
ing Green, Ky., or Huntsville, Ala.

and the richness of this fauna the collector has only to
lections as that of Messrs Wachsmuth and Springer at
a., or the state collection at Springfield Ill.

cality in the world has yielded such a richness of forms
s Burlington, Iowa. It was here that many structural pe-
Crinoids were discovered or more perfectly understood,
rom the Illinois state reports on geology and palæontol-
ritings of Wachsmuth and Springer.

ecting ground (Pike Co., Mo.) while the Lower Burling-
e is represented by its usual thickness of thirty to fifty
er beds are but poorly represented by a few feet of lime-
e cherts scattered over the hills and along the streams.

with the higher plates of the calyx of the two last named of the genera are quite as common as lone calyces.

Imperfect examples of Batocrinus and Eretinocrinus are generally specimens without the basal plates, only. Sometimes an individual has been injured about the base of the anal tube, but rarely. Imperfect Dorycrini either want the basal plates or have suffered breaks in the vault at the spine bases or around the anal aperture. Ollacrinus and Rhodocrinus are rare in any condition. Usually as isolated calyces. Sacocrinus is rare and seldom has the vault in place.

In a very few instances we have noticed remains of small radiating calyx tubes that were imbedded in the substance of the radial plates, and have traced them from the middle of the first radial to the arm bases, bifurcating with the plates. Similar rods on the ventral surface are not rare, but we do not remember having seen any notice of these radial tubes in the calyx, by any writers on crinoids. Fragments of these tubes can be distinctly seen on a specimen of Physetocrinus in our collection. As these tubes, represented by delicate rods in the casts, were free their entire length, the slightest jar would usually destroy them and so not one cast in a thousand shows any traces of such vessels.

Among blastoids, Pentremites elongatus is the rarest with one exception, a Troostocrinus? represented by but one specimen in the collection. Of hundreds of examples of Granatocrinus norwoodi not one shows the central opening above closed by plates, while specimens of Schizoblastus sayi not unusually show this feature.

Specimens of G. norwoodi often preserve the ambulacral rods but the jar in breaking the flints usually destroys them The preservation of these rods on S. sayi is much more rare.

On many of the casts of blastoids the spiracles and hydrospires are well shown. No specimens of blastoids have been found with pinules attached.

We have one specimen of a Platycrinus which had a rather large anal opening entirely closed by minute plates. Perhaps it is an abnormal feature.

R. R. ROWLEY.

Curryville, Mo., March, 1890.

MODIOLOPSIS OBLONGA. In the May number of the GEOLOGIST, vol. v, p. 272, Mr. Ulrich describes a species with the above name. It is unfortunately pre-occupied, Mr. U. P. James having in 1882 proposed this name in place of *M. sub-spatulata* which had been previously used by him, and which Hall had also used. (See "The Palæontologist," Sept. 12, 1882, p. 53).

JOSEPH F. JAMES.

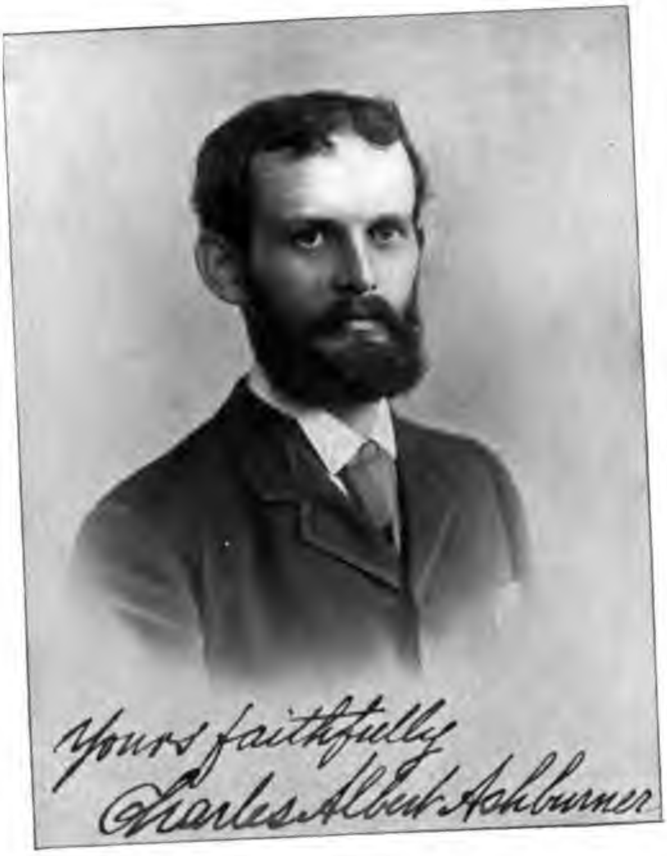
Washington, D. C., April 29, 1890.

PERSONAL AND SCIENTIFIC NEWS.

J. W. Spencer, State Geologist of Georgia, who has ngland during the winter months, has returned, and med his work. His address is Atlanta.

hirty-ninth meeting of the American Association Advancement of Science will be held at Indianapolis, ining August 19, 1890. Committees of the Indiana y of Science, and of the citizens of Indianapolis are ac- gaged in the preliminaries of this session. The enthus- ich they manifest bespeaks a full and very satisfactory There will be, in connection with this session, the meeting of the Geological Society of America, in which ogists of America are specially interested. Numer- ortant papers will be presented.

ecent Meeting of the Geological Society of Lon- . 26, 1890, Dr. George J. Hinde exhibited specimens roscopic sections of Radiolarian chert from the Ordo- rata (=Llandeilo-Caradoc) of the southern uplands of , in the counties of Lanarkshire and Peebleshire. The s were submitted to Dr. Hinde by B. W. Peach, Esq.,



Yours faithfully
Charles Albert Ashburner

THE

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CHARLES ALBERT ASHBURNER.[1]

By ARTHUR WINSLOW, Jefferson City.

Charles Albert Ashburner was born on February 9th, 1854; he died on December 24th, 1889. The time of birth, the time of death, these are the abcissæ of man's activities on earth; by the magnitude, by the qualities of his works are the ordinates measured; the area thus limited expresses the value of the life; the bounding curve, often irregular, is a function of many variables, but all are assignable to heriditary traits or to the conditions of life. The abcissæ, the periods of activity, we can readily express in units of time; but who can gauge the ordinates, the qualities of these acts? Infinite wisdom only. We can but surmise, can but express opinions, at best approximate. Of values, the future is the best judge; for, in proportion as a man's character and work affect the future, through the present, so should his value be measured. With us, the contemporaries, it rests, however, to hand down, to this tribunal of the future, accurate pictures of those who pass away; pictures which shall be for ever inseparable from the works of those whom they represent; that future generations may know of what manner of man the work perishes, of what manner of man it endures forever. With this feeling is this sketch prepared, with this sense of the obligations involved; prepared

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[1] For much of the matter contained in this sketch, the writer is indebted to Mrs. Ashburner and to Mr. O. B. Harden, of Pittsburg, Pa.

ho knew Mr. Ashburner first as a superior officer,
a professional associate and friend.
ing with the time of his birth, we will touch upon the
To the bare narrative of facts we will add such sug-
such interpretations and such illustrations as will,
lm judgement, help to best picture the man, claiming
only the recognition due every honest opinion, and
onfident in the belief that, in proportion as it is truth-
his picture live.
sburner's great grand-parents on both sides, came di-
Philadelphia from England, about the time of the
on. His father was Algernon Eyre Ashburner, the
Sarah [Blakiston] Ashburner, and he one of the nine
of whom only two are now living. Of what are recog-
English traits there seemed to be, however, no rem-
in Ashburner. On the contrary, his impulses, his
ttitude and his acts were typically American. He was
ous temperament, his action quick, his mind inventive
le in resources. How much of this was inherited,

phia in 1873; further, upon graduation, he accepted a position on a light-house survey, under Gen. W. F. Reynolds and with professor Lewis M. Haupt. But, in the same year, on the organization of the second geological survey of Pennsylvania, he seems more than ready to leave this work of the civil engineer to begin his life's work as a geologist, even as a volunteer assistant on the survey. Thus early did this friendship of professor Lesley make itself felt, and it was ever after an important factor in Mr. Ashburner's life; a strong and sincere attachment which now expresses itself in beautiful, but pathetic words of grief for the departed pupil and friend.

We can add nothing to what has already been written of the first years of his work on the Pennsylvania survey, of his work in Mifflin and Juniata counties in 1874, in the Aughwick valley and East Broad Top district in 1875, in McKean, Elk, Forest and Cameron counties in 1876.

It was in the late summer of 1881 that we first met Mr. Ashburner, at Wilkes Barre in the Wyoming valley, he, then, but recently married. The work of the survey of the anthracite regions was already planned in detail, branch offices were opened at Pottsville, Hazelton and at Wilkes Barre, and much progress had already been made. It was a time of buoyant moods with Ashburner. He was under the exhilarating effects of the opening of a successful professional career. He gloried in his responsibilities and in the importance of the work entrusted to him—he only twenty-seven years of age. To some he seemed over confident, enough to excite scepticism, while others would find cause to take slight offense. But there was no bad feeling, no real arrogance in his self reliance.

From early in the year 1882, for over two years the writer was associated with Mr. Ashburner in the work in the anthracite regions. Though not the first to use the contour method of illustrating under-ground structure, Ashburner seems to have been the first to use it extensively and his results are certainly unparalleled. And this very case of applying to so general an end a process which hitherto had been of such limited use, was an illustration of what was one of his characteristic traits, i. e. what has been called the "adaptive faculty", or the power of putting to their best uses, of extracting the full value of such means as were at his disposal. He was fertile in expedients. He was, perhaps, rather an organizer, a man of system, than a

think, wishing youth-like, to be free from all restraint
sented it at times, but, since, have appreciated more, tl
ıs rather a striving with him to reach his ideal of the a
ent of parts, than an arbitrary exercise of power. He
ımself, a most unremitting and persevering worker.
ıdgement of men, his power of reading character was
nd hence his selection of assistants and his allotment of
ere generally admirable; and, as writes a critic, he had
ıarked degree, the ability of making the best possible u
his work. At one time we thought he did not properly a
iate our share in such, but have since had cause to m
his opinion.

To his assistants he was most kind and cordial, encour
hem to develop the best that was in them, and, to his f
y interest in their careers and to his loyalty in after life,
can testify. But he was not what is called a "magnetic r
there were many who did not like him, though generally
nizing his ability; his self-confidence was not always flat
to the self-esteem of others; yet his versatility and inf
tion on a wide range of topics made him a most entert
companion. That which was sterling in him did not
out on first and short acquaintance; in fact it was years
the lovable and the cordial of his nature became appar
some; traits to which the warm expressions of many n
eloquent tribute.

The work in the anthracite regions and other duti
nected with the Pennsylvania survey, occupied Mr. Ash
until late in the year 1886. At this time he had held th
tion of first assistant geologist for over a year, having
supervision of all the office and field work of the surve
from the Pennsylvania sur

He continued in an advisory capacity with this company up to the time of his death, having reported upon and advised on the drilling of a large number of gas and oil properties. During this time he made a large number of reports for private interests, outside of his connection with the above company; for, having made the subject of the occurrence of oil and gas a special study, his services were much sought after.

In September, 1888, he was elected general manager of the New York and Montana Mining and Milling Company, and retained that position until a month before his death.

In the fall of 1888 he was commissioned, by Mr. George Westinghouse, Jr., to investigate and report upon a number of copper properties, and, after many negotiations and personal examinations, he purchased a large property in southern Arizona, and when the Duquesne Mining and Reduction Company was incorporated, in December, 1889, he was made Vice-President and General Manager.

On November 2nd, 1889, he left Pittsburg for the west for the purpose of starting mining operations, after having been delayed for several days on account of a cold which had clung to him after his return from a trip to Ottawa. This visit to the west was for the purpose of buying and transporting, twenty miles from a railroad line, boilers, engines, and everything necessary to inaugurate a new mining enterprise, and, as was his wont, he went at it in his enthusiastic way, and so overtaxed himself. But, little thinking of the approaching end, he writes from Tombstone, under date of November 20th, in glowing terms of his professional success and prospects, and concludes with the following words, which now sound most pathetic: "I hope some day I may be sufficiently well off to return to state geological work where my heart has always been." But soon after, on November 26th, he writes from Tucson that he has been much delayed during the week by a severe attack of sickness which prostrated him and which his physician thought might develop into mountain fever. After staying at Tucson a few days, he went to Wilcox to report on a gold and silver property, some thirty miles or more from the railroad, and he thought that the drive into the mountain would do him good; but, on his return to Wilcox, feeling no better, and finding a message of solicitation from

decided to return and not to go on to San Francisco
templated.

rned home on December 9th, and on that day spent
our at the office. He was advised by his physician to
home, which he did, attending to business matters
me up. On December 16th his condition became
ng to Bright's disease, that he was compelled to take
. Sick as he must then have been, however, it did
ve him of his natural geniality and hopefulness
future. Accepting, as he had, the responsibility
appertained to his new enterprise, he wanted his hand
lm, to know that everything was going as it should
a, and up to the day before he died he directed the
the Duquesne Mining and Reduction Company;
was induced by Mr. Westinghouse to give up all
of business, and to try to get well. On that day he
en in pencil a letter of four pages to Arizona, and had
verything preparatory to taking a rest and to getting

the United States Survey in 1885, and issued reports for 1885, 1886, 1887 and 1888. He took great pride in the collection of these statistics and the issuance of the reports, so much so, that the work was largely a labor of love. In August, 1889, he assumed charge of the collection of the coal statistics of Pennsylvania for the Eleventh Census, as special agent, and was engaged on this work at the time of his death.

Mr. Ashburner was a member of Calvary Episcopalian church at East Liberty and a member of its brotherhood. Of him, a former rector writes: "One can never measure the influence of such a life as his, full of active benefit to his fellow men in the world, doing his full duty as a scholar and man, honored for his ability and devotion to his secular work, and yet always bearing witness for his Lord and for his faith by the upright, loyal, christian character of his manhood." Further, writes another, and an intimate friend: "One of Charles Ashburner's pet ideas was the harmony [or rather the identity] of true Religion and true Science."——"Abreast with the most modern thought, accepting every established doctrine of the latest science, he yet saw in none of these anything whereby he was debarred from an honest confession of his Lord and Savior in the Christian creed, nor from a due and faithful reception of the holy sacrament."

Mr. Ashburner was an active member of the following societies: American Philosophical Society; American Institute of Mining Engineers; Philadelphia Academy of Natural Sciences; American Association for the Advancement of Science; American Society of Naturalists; Engineers Club of Philadelphia; Honorary member of the Lackawanna Institute of History and Science; Franklin Institute of Philadelphia; Trinity Historical Society; Texas Historical Society and a Corresponding member of the Wyoming Historical and Geological Society.

A review of his publications and of his works would be beyond the scope of this paper. These publications and this work are now before the world and their worth is being tested every day. They can be consulted and judged of by many, and many are familiar with them. An estimate of their relative and absolute values has already been given by one more

to judge than the writer.[3] Thus we will be content
ing the following list of his professional papers,
their number and by the importance of their topics,
measure of the prodigious industry of the man and
racter of his work. All of this he had produced and
ot reached his prime. Surely, death seems to have
cut short a most useful career. But, though the
one, though the body is dead, the man yet lives in
vorks and this influence will never die.

on of the Discovery of Vespertine Coal Beds, Huntingdon
mer. Inst. Min. Eng., Cleveland, Oct. 1875.
the Palæozoic strata of Huntingdon Co. Pa.; Amer. Inst.
hila. June 1876.
Formations in Middle Penna.; Amer. Phil. Soc. Feb.

on of the Wilcox Spouting Water well; Amer. Phil. Soc

ands of Penna. Engineer's Club, Phila. Feb. 1878.
the Metric System; Engineer's Club, Phila. April, 1878.
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Ditto Western Middle, Do 1884.
Ditto Eastern Middle, Do 1885.

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Description and production of the Coal Fields of the U. S. 1887, issued in 1888.; Mineral Resources.

in practical geology; Amer. Soc. Nat. Washington, Dec.

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Rep. Geol. Sur. Pa. 1885.

n of the Westinghouse system for regulating the pressure
Gas; Amer. Manuf. Vol. XLI, No. 22.

luction in Utah 1886; Amer. Inst. Min. Eng. July 1887.

ral Geology; Encl. Britan., Amer. Reprint. Vol. 7.

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tto, Missouri. }
exploration for Natural Gas. }

Petroleum. Its history; Geology; Technology; Trans-
Refining; Statistics; Chatauquan Mag. Feb. 1888.

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1886.

eological Atlas, Anthracite Coal Fields of Pa. Parts 1 & 2,

lopment and Statistics of the Alabama Coal Fields for 1887;
. Min. Eng. Vol. XVII.

ogy of Buffalo as related to Natural Gas explorations along

Lingula, *Obolella*, two *Acrothele*, *Acrotreta*, three *Hyolites*, a *Gasteropod* and a *Protospongia*. The Norway Bohemian formation is characterized, like that in Sweden by the *Paradoxides* and its great number of *Agnostus* in the upper beds with the existence of *Orthis* at Krekling.

In his admirable paper: "Parallèle entre les dépôts siluriens de Bohĕme et de Scandinavie", Prague, 1856, Barrande has signalized the existence of a land barrier between Scandinavia and Bohemia; and more than once, he has called attention to the great difference between the Paradoxides faunas of Europe, saying that the faunas were as well defined and localized to special regions or provinces during the Taconic period as they are now in our oceans. A great truth, which all subsequent researches all over the world, has proved to be a most valuable law, applicable to all the periods through which our globe has passed, since life made its apparition on its surface.

British Isles.—The Bohemian formation or *Paradoxides* zone, was pointed out as existing in the British Isles as far back as 1850, by Barrande, when on a visit to the Museum of Practical Geology in London. A specimen of *Paradoxides*, not well preserved and fragmentary, without any label of any sort, but surely British, found by him in the Museum recently created by de la Bĕche, Edward Forbes and Salter, led Barrande to assure the English geologists, that the primordial fauna existed some where in their country. Is it not strange, that English pride of having the right to name and classify the older Palæozoic rocks, to the exclusion of the discoveries made in all the other countries, as it was assumed at the Berlin International Congress of 1885, by the Director General of the geological survey Mr. A. Geikie, should have received such a helping hand, in in a rapid visit to one of their museums.

As soon as Barrande had called their attention to it, they began to look more carefully over their Lower Palæozoic rocks of Wales; and Salter more especially devoted many years in hunting for an English locality of *Paradoxides* when finally twelve years after Barrande's visit and valuable indication of the existence of the *Paradoxides* zone and of the primordial fauna in the British Isles, Salter had the good luck to find *in situ* at St Davids the "gigantic trilobite long looked for in Britian": *Paradoxides Davidis!* That discovery modified profoundly the English classification, which until then was

otwithstanding
nd he may be considered as the representative of Barra
ngland. It was not until 1856, six years after the cele
isit of Barrande to the different museums in Novembe
ecember, 1850, that Salter first discovered *in situ* onl
rimordial fossils; *Oldhamia* in Ireland, and a head of a
ite in the Longmynd group of Sedgwick. Previously
rimordial trilobites, recognized as primordial by Barra
850, had been collected accidentally in the *Lingula* flags
Bangor district, and had been described by Salter in th
ades of the geological survey, and also before the Britis
sociation in 1852. But after the discovery of the St. Da
cality, then the primodial fauna of the British Isles was
ly developed, thanks to the combined efforts of Salter,
Homfray, Dr. H. Hicks, Prof. R. Harkness, C. Calla
Lapworth, Kinahan, etc. As Salter rightly says: "
(Barrande) therefore belongs the whole credit of origi
the term, and defining the fossil characteristic of this
dial zone a group of rocks which grows in distinctness a
logical importance day by day" (The Geology of North
p. 245, London, 1866, in the 3d Vol. *Mem. Geol. Surv.
Britain.*)

Salter in his "Catalogue of the collection of Cambri
Silurian fossils," Cambridge, (England) 1873, 4to, divi
Paradoxides zone or Bohemian formation, into three sub
called:

a. Longmynd group.
b. Harlech or Bangor group.
c. Menevian group or Lower Lingula flags.

The superposition of those sub-groups is doubtful an
English geologists consider the Menevian group of S
contemporaneous with the Longmynd and Harlec

tionary measure in order to control all future discoveries of primordial fossils in the area of Wales and vicinity. Very likely the Menevian is the homotaxis of the greater part of those ill-defined groups the Longmynd and Harlech.

The fossils of the Bohemian formation of Great Britain are: *Parad. harknessi*, *Par. davidis*, *Par. hicksii* and *Par. aurora*,one *Conocoryphe* or *Conocephalites*, two *Microdiscus*. one *Arionellus*, *two Anopolenus*, and three doubtful *Olenus?* one *Holocephalina*, a *Plutonia*, ten *Agnostus*, four *Primitia* and one *Hysnenocasis; Discina*, three *Oboleta*, *Lingulella*, one *Orthis*, five *Theca*, *Stenotheca*, *Cyrtotheca*, two *Oldhamia*, two *Protospongia* and one *Cyrtidea*. As a whole the British Bohemian fauna, although related to Barrande's fauna of Bohemia, had more affinities with the Bohemian fauna of Sweden and Norway. The *Agnostus* is very abundant in the uppermost part of the formation, as it is in Norway.

France.—It was not until 1888, that a patch of the Bohemian formation or *Paradoxides* zone was found at Ferrals-les-Montagnes, Hèrault. in France, by M. Jules Bergeron. That locality of the "Montagne Noire," northeast of Carcassone, in Languedoc, presents a small outcrop of red, yellow, and green slates only 36 feet thick, containing a *Paradoxides*, one *Arionellus*, two *Conocephalites*, and several species of *Agnostus* ("Faune primordiale-Paradoxidien-dans les environs de Ferrals-les-Montagnes [Hérault]," in *Bulletin Soc. Géol. France*, vol. xvi, p. 282, Paris). From the scanty notes published so far, we may infer that the Ferrals primordial fauna, shows affinities and relationship with the faunas of Bohemia, Sardinia and Spain, and they seem to indicate that it belongs to the same Middle Taconic province, which may be called Asturio-Bohemia province; as the province of England, Norway and Sweden may be called Scanio-Wales province, making two distinct zoological provinces in Europe for the *Paradoxides* zone or Bohemian formation.

Sardinia.—To the northwest of the town of Iglesias, between Malfid and Masua, and at Canalgrande (See *Carta geologica d'Italia*, scale 1:1,000,000, in two sheets, published by the geological survey of Italy, Roma, 1889), on the sea shore there are several outcrops of fossiliferous primordial rocks. The classification of strata have not yet been given with all the details required for a complete understanding of the stratambrischen Schichten systems der Insel Sardinien."

These two important paleontological works enable ı ay with certainty that the *Paradoxides* zone or Bohemiaı ıation is well represented in Sardinia. Very likely a pa he Upper Taconic, more especially the *Olenus* zone, e lso there. Further detailed sections and close researc ossils will further develop the first discovery of the primc auna, made, as far back as 1857, by the late general Al le la Marmora in the island of Sardinia. Meneghini ha: ribed 3 *Paradoxides*, 6 *Conocephalites*, 2 *Conocoryphe*, 1 *racus* and 5 *Anamocare*; besides 5 *Olenus* which seems r n the same beds with *Paradoxides*, an abnormal assoc which requires to be carefully looked after, before ıccepted as an indisputable fact.

Spain.—In 1859, Casiano de Prado, found the *Parad* zone north-east of Leon, between Sabrero and Boñar l'existence de la faune primordiale dans la chaine (brique;" *Bulletin soc. géol. France*, vol. XVII, p. 516, 1860). Barrande and de Verneuil published the fossils by de Prado, and here is the list: ' *Paradoxides*, *Arionc* *Conocephalites*, 2 *Agnostus*, *Leperditia*, *Capulus*, *Discina*, (*Orthisina* and a Cystidean. Barrande insists on the analogy of the *Paradoxides* zone of the Cantabric chai the one of Bohemia; three species of trilobites being ide

In 1882, M. Charles Barrois published his geological s and researches on the Asturias, a very remarkable and able work entitled; "Recherches sur les terrains ancie Asturies et de la Galice," p. 168, etc. in *Mém. Soc. géol* vol. II. Lille. M. Barrois has recognized the *Para* zone or Bohemian formation at la Vega, Rivadeo and the Taconic system exists in the provinces of Ciudal-Real, Caceres, Andalusia, Grenada, Alemtejo (Portugal) and Tras os Montes (Portugal), but further researches are wanted before a final classification of the different patches in Spain and Portugal may be properly attempted.

Newfoundland.—Resuming the stratigraphic researches of Messrs. Howley and Murray, and the paleontological works of Messrs. Billings, Whiteaves and himself, Mr. G. F. Matthew, in his interesting paper, already quoted, "Cambrian faunas of Newfoundland" pp. 149-151, gives the following sub-divisions of the *Paradoxides* zone :

A.—Horizon of Agraulos strenuus.———Holmia Zone.
B.——id.——of the Conocoryphinæ.—Paradoxides—id.—
C.——id.——of Paradoxides spinosus. —id.—— —id.—
D.——id.——id. ——id.—— tessini.———id.—— —id.—
E.——id.——id. ——id.—— davidis.———id.—— —id.—
Fauna of Olenus division of Kelly's island and Great Bell island.

As we have seen before, division A contains *Holmia* (*Paradoxides?*), and belongs to the Scandinavian formation or *Holmia* (*Olenellus*) zone. There remains only four sub-divisions B, C, D and E, of *Paradoxides* beds. They are all situated in St. Mary's, Conception and Trinity bays, in the south-eastern part of Newfoundland.

What Mr. Matthew calls "fauna of the Olenus division" from Kelly's island and Great Bell island, is so far very limited and rather meagre, but further researches may develop it. At Bell island Mr. Howley has found a large trilobite, undetermined, rather rare; and the other fossils quoted by Mr. Matthew: *Eophyton*, *Arthraria*, *Lingula*, *Lingullella* and *Cruziana*, are all old forms.

Mr. Howley in his column of primordial strata, calls the *Paradoxides* beds of St. Mary's and Conception bays, division *n.* Then *o.* and *p.* designate a limestone of Highland cove (Trinity bay) with *Paradoxides* ; and divisions *q*, *r*, *s*, show the thick formation of Kelly's island and Bell island of Conception bay, just spoken of in the preceding paragraph.

According to Mr. Matthew, the *Paradoxides* zone fauna of his divisions B., C., D. and E., is composed of 5 *Paradoxides*, 3 *Microdiscus*, 3 *Conocephalites*, *Agraulos*, *Selenopleura*, *Anopolenus*, *Centropleura* and 12 *Agnostus*, *Hyolites*, *Obolella*, and *Eocystites*. All these are forms of the Bohemian formation of England, Norway and Sweden. The similarity of the fossils ites, found by him at Manuel brook in Conception bay s *Paradoxides hicksi*, *Ctenocephalus*, *Liostracus*, *Erin* *Ptychoparia*, *Holocephalina*, *Linnarssonia*, *Acrothela* and

The locality of Branch at St. Mary's bay, containin great *Paradoxides bennettii* and *Agraulos affinis*, is very t the base of the *Paradoxides* zone, like the Braintree *loxides* beds of Massachusetts, and also Band *c.* of divi of the St. John group of New Brunswick, called for Newf land by Mr. Matthew "B. Horizon of the Conocoryph Probably more minute and new search in St. Mary's ba bring more fossils and throw more light on the lower h of the *Paradoxides* zone of eastern North America.

New Brunswick.—In 1862, many years after the discov the Paradoxidean fauna by Dr. Emmons, and even s years after the discovery of the Braintree *Paradoxides* a St. Mary's bay *Paradoxides*, Rev. C. R. Matthew, found doxidean trilobites near and even in the town of St. New Brunswick. My lamented friend, the late Frederi Hartt, determined and described the fossils collected two Messrs. Matthew and himself in 1865 and 1868. ward Billings added a few species; and finally Mr. Matthew, since 1877, has made extensive collections rou John, and has published important stratigraphic and p tologic memoirs, so that he has made St. John the locality for the *Paradoxides* zone or Bohemian forma eastern North America, and one of the most important in the world.

Since Barrande's admirable studies on the primordia bites, nothing so important and so thorough, has bee lished as Mr. Matthew's remarkable "Illustrations of the 1882 1887 4to the nomenclature of the strata containing the primordial fauna. As a true English geologist, with a patriotic leaning (¹), intensified by his stay in a colony of the British crown, Mr. Matthew adheres to the word Cambrian—not the primitive Cambrian of Sedgwick, but a lately made up Cambrian—for the name to be given to all the strata containing the primordial fauna, against plain facts of priority in favor of the name Taconic, first used by American geologists, as far back as 1844 and 1842, many years before the discovery of the primordial fauna in the British Isles and in all the British colonies. Barrande was more just, for as soon as he was acquainted with Dr. Emmons discoveries, with a true scientific and liberal spirit, he did not hesitate to publish his complete adhesion to them and to proclaim that an American geologist had discovered first the primordial fauna and the Taconic system in which it is located. But Barrande had a cosmopolitan and widely open mind, and a sense of justice very rare among geologists and paleontologists.

Mr. Mathew divides his "Series 1. B.—the St. John group," which represents in New Brunswick the Bohemian formation or *Paradoxides* zone, into four bands or assises *a. b. c.* and *d.* The fossils are: 6 *Paradoxides*—one species the *Parad. eteminus* has four varieties, and another one the *Parad. regina* in honor of her majesity, Queen Victoria, is the largest sized *Paradoxides* yet found—*Ellipsocephalus*, 2 *Solenopleura*, *Ptychoparia*, 2 *Liostracus*, 3 *Agraulos*, 2 *Conocoryphe*, 3 *Microdiscus*, 8 *Agnostus* with four varieties; *Primitia*, 2 *Beyrichona*, *Hyponicharion*, *Lepidilla*, 2 *Lepiditta*, *Harttia*, 6 *Stenotheca*, 2 *Diplotheca* with four varieties, 3 *Hyolites*, 2 *Orthis*, 2 *Kutorgina*, *Acrothele* with two varieties, 2 *Acrotreta*, 2 *Linnarssonia*, 3 *Lingulella*, *Eocystites*, 2 *Hydrozoa* or *Graptolites*, *Eocoryne*, *Protospongia* and

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(¹) It is extremely difficult for English geologists to accept and use nomenclature made outside of their islands. I remember forty-five years ago, how they were opposed to the use of the names Jura and Jurassic system, instead of Oolite and Oolitic system. It took three and four generations before they were reconciled to that beautiful name of Jurassic series. The Trias also was strongly opposed as a name, because it originated in Germany. As to Dyas instead of the wrongly created Permian, it begins only now to be used, notwithstanding the long admitted error of Murchison, who confounded the whole Russian Trias with the Zechstein and Rothliegende. So we must expect a long opposition by English geologists to the use of the American name of Taconic; and very likely it will take five or six generations before they come to it.

harlani, a very large trilobite closely alli to *Parad.* of Bohemia and to *Parad. bennettii* of Newfoundl 1 *Ptychoparia*, an *Arionellus* or *Agraulos* and a *Hyolites;* four species. It represents the same horizon as the be Branch on the St. Mary's bay, Newfoundland, and belong the lowest horizon of the *Paradoxides* zone.

NEVADO-CANADIAN LOWER AND MIDDLE TACONIC.—Now we have reviewed all the outcrops of the Lower and Mi Taconic strata of the Acadio-Russian sea, and have trie give a clear and exact classification and nomenclature in great formations or groups, we shall describe and compa patches of Lower and Middle Taconic existing in the Ne Canadian sea, the original region of the Taconic systen the first place in the world where the primordial faun found and described as the oldest fauna existing belo Cambrian fauna of Wales.

Tabular view of the Lower and Middle Taconic of the Nevado-Ca sea.

IV. Georgia formation or Elliptocephalus (Olenellus) zon
III. and II. St. Albans formation.
I. Chuar formation of the Grand Cañon of the Colorado

Original Taconic area.—The Acadio-Russian sea of th conic period, was separated from the Nevado-Canadian a long isthmus extending from the eastern coast of La to Rhode Island and southeastern Massachusetts. points the isthmus was very narrow and can be con with the present isthmus of Panama and Tehuantepec first place was between Canada bay in the extreme eastern part of Newfoundland and Bonavista bay, south Newfoundland, a distance of 150 miles; and the secon was between Braintree near Boston and Attleboroug Providence Rhode Island, a distance of only 35 mile quently of the *Paradoxides* zone; and at Canada bay and at Attleborough we have the fauna of the Georgia formation or *Elliptocephalus* (*Olenellus*) zone, different as regard species, and even forms of the trilobites form the fauna of the Bohemian formation. We have on the two sides of that great isthmus two faunas which can be parallelized and are at least partly homotaxical.

The deposits of strata on each side, are quite different lithologically, although having in common the slaty characters of the principal masses of rocks. In the Acadio-Russian sea the slates and argillites contain, very seldom, limestone nodules or very small limestone lentilles, called *Kalkboller* at Krekling in Norway and *boulder-like masses* at St. John, New Brunswick, of extremely limited dimensions, varying in size from nodules of only one inch across, to elliptical masses of about a yard in diameter, while in the Nevado-Canadian sea the slates inclose great lenticular masses of limestone, generally more or less dolomitic; which vary in dimensions from the size of a man's head to knobs of prominent spherical masses of fifty yards and even more in diameter, as round St. Albans, in Vermont, or elongated lenticular masses from twenty-five yards long to one thousand yards and even more, as we find them at Phillipsburgh, Highgate falls, Pointe-Lévis, Bic harbor, and in many places in Vermont, New York, Massachusetts and Rhode Island. The importance of the deposits in the Nevado-Canadian sea is due, not only to their great thickness and their peculiar lithology, but also and mainly because, it was while studying them that by a stroke of genius Dr. Emmons recognized that they belonged to an older system, than any known until then, and that they were characterized by a special fauna, totally different from the faunas previously discovered and signalized in Europe and America. It was a gigantic step, which displaced the base of the Palæozoic strata, carrying it down twenty-five thousand feet lower than Sedgwick and Murchison had done by their researches in England and on the continent of Europe.

These discoveries of Dr. Emmons were made from 1838 to 1844, and published, first in his "Final Report of the second district of New York" (Jan. 1, 1842), and finally in 1844, in "The Taconic system, etc." Two years later Barrande in his "Notice préliminaire sur le système Silurien et les trilobites de

ot know Emmons
;ot hold of Emmons' publications, he disavowed all cl
riority, and with his great honesty and courtesy, h
'I fear that some one may attribute to me the merit of
y which I am far from pretending," * * * "it i
hat Dr. Emmons has first announced the existence of
anterior to that which has been established in the S
ystem as characterizing the Lower Silurian division and
I have named second fauna. It is then just to recogni
priority, and I think it all the more fitting to state it
time, that it has not been claimed to this day" ("Doc
anciens et nouveaux sur la faune primordiale et le s
Taconique en Amerique," in *Bulletin Soc. géol. Franc*
XVIII, p. 225, Paris, 1861.)

After Barrande's noble words and the continual disc
of the primordial fauna in the Taconic strata of North
ca, the "cardinal principles of geologic nomenclature,
ity of definition, and 2 accuracy of the original observat
they are called by a recent writer, will forcibly one da
other, lead all geologists to use the name Taconic, in th
al classification of the world. It is only a question
and justice, and in geology time is everything, as to j
will come as a consequence of truth against all nation
dices and interested oppositions.

Dr. Emmons' classification of the Taconic strat
original Taconic area of western Massachusetts an
New York, comprises five divisions, two of which
the Upper Taconic *b* and *d*, and the three others *a*, *c*
the Middle and Lower Taconic. In the "Granular q
division *c*, we have a small fauna indicating that i
likely contemporary and homotaxical of the Scandin

the Georgia formation in Franklin county, Vermont," ("The Taconic system of Emmons, etc." in *Amer. Jr. Sc.*, vol xxxv, p. 234, 1888); it is impossible to say what sort of trilobite it is. Mr. Walcott's determination of *Atops trilineatus* Emmons, as identical with *Triarthrus beckii*, his belief that *Elliptocephalus* (*Olenellus*) *asaphoides* is "generically identical with *Holmia kjerulfi* and *Schmidtia mickwitzi*," and also his reference of the original *Microdiscus quadricostatus* Emmons to *Trinucleus concentricus*, saying that "we now know that the light colored fragile shales of Augusta county, Virginia, belong to the Hudson River group," are examples too conspicuous of his way of identification of species and genera, and determination of age of strata to enable us to accept his conclusions, without the most positive documents, with good figures and accurate descriptions. His extraordinary announcement that *Olenellus* (*Elliptocephalus*) *thompsoni* was found ranging in 14,000 feet of strata in New York and Vermont, is another suspicious discovery which requires to be controlled by reliable stratigraphic observations before being accepted. It is best to regard his *O. thompsoni* of the Granular quartz of the vicinity of Bennington, as not identical with the trilobite of Georgia, but as a Paradoxidean form, which may belong perhaps to *Holmia* or to *Schmidtia*. In such cases we may have the Scandinavian formation, or even perhaps the Esthonian formation of Europe. Further researches are necessary before reaching final conclusion.

Provisionally regarding the division *e*, Granular quartz of Emmons, as Lower Taconic and the homotaxis of the Esthonian formation, his division *c* Magnesian slate, and *a* Black slate, belong with certainty to the Middle Taconic or Scandinavian and Bohemian formations; because in them are found the true primordial fauna of the Georgia formation of Vermont. The list of fossils in the original Taconic area, for the vicinity of Bald mountain (the first place in the world where the primordial fauna was recognized as a special fauna), the vicinity of Troy, Dutchess county, etc., is: *Atops*, 2 *Elliptocephalus*, (*Paradoxides* of Barrande; *Olenus*, *Barrandia* and *Olenellus* of Hall), *Pagura*, 4 *Microdiscus*, *Ptychoparia*, *Solenopleura*, *Olenoides*, 3 *Agnostus*, 2 *Leperditia*, 6 *Hyolites*, *Platyceras*, *Stenotheca*, *Scenella*, *Fordilla*, *Orthis*, 3 *Obolella*, *Lingulella*, *Kutorgina*, *Linnarssonia*; all representative species of forms most characteristic of the *Paradoxides* zone or Bohemian forarmer, Mr. N. E. Parker, fifty yards from his h… by Messrs. James Hall, Logan and Hitchcock to the Hud River group, or even to a special group above it. Barra seeing that this singular and curious stratigraphical posi given to his primordial fauna, would involve a transfer al the second fauna, and consequently break down his recor good observer, as well stratigraphically as paleontologic begged me repeatedly to go there and make the stratigraph section. This was done in 1861 and 1862; and my classi tion on the succession and true stratigraphic position of Taconic or primordial faunas in America, is the first syst atic arrangement of the formations containing them, that made and published on the basis of the paleontolog determinations of Barrande, and against the extraordi stratigraphic and paleontologic views of Hall and Logan.

Here is the order of succession, as I published it in and 1862. (¹)

Table of the Taconic of Vermont (Proceed. Boston Soc. Nat. Hist. VIII, p. 241, 1861.)

Potsdam sandstone 300 to 400 feet. *Conocephalites.*
Lingula flags 500 to 600 feet. *Lingula, Orthisina, Orthi Graptolites.*
Georgia slates 500 to 600 feet. *Paradoxides (Olenellus) thompsoni Peltura, Conocephalites, Obolella, Orthisina, Camerella.*
St. Albans group 2500 to 3000 feet. Tribolites undetermined

Table of the Taconic in Vermont (Letter to M. J. Barrande on the Ta p. 4. Cambridge, 1862.)

Potsdam sandstone 300 feet. *Conocephalites* and *Obolus.*
Swanton slates 2000 feet. *Graptolites.*
Phillipsburgh group 1500 feet. *Dikelocephalus, Bathyuru Camerella* and colonies of second fauna.
Georgia slates 400 feet. *Elliptocephalus (Olenellus) thompson Conocephalites, Obolella, Orthisina, Camerella.*
St. Albans group, 5,000 feet, with roofing slates and granular

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"Second contribut

The Georgia slates represent the Bohemian formation of the Acadio-Russian sea, or *Paradoxides* zone with its characteristic fossils, such as, *Elliptocephalus* (*Olenellus*) *thompsoni*, 2 *Protypus*, 2 *Conocephalites* (*Ptychoparia*), *Olenoides? Mesonacis*, *Peltura* (*Bathynotus*), *Solenopleura*, *Agnostus*, *Salterella*, *Hyolites*, *Scenella*, *Orthisina*, *Camerella* (*Kutorgina*), and two *Graptolites*. I have not signalized sooner the existence of *graptolites* in the Middle Taconic, although it was first recognized by Dr. Emmons, and Mr. Matthew has found one species at St. John, because that rather problematic and very low organism has been used too freely, and the consequence has been on the part of the adversaries of the Taconic system, a confusion in the classification of the great Taconic slaty rocks, with the Utica slates and Lorraine shales. More careful studies of the forms and more strict stratigraphical determination for their *habitat*, are required before we can know their value in the classification of strata.

The St. Albans group was created to place in it all the strata existing between the band of the Georgia slates or formation in Franklin county, Vermont, eastward of Parker's farm outcrop, and the talcose slates and conglomerates of Fairfield. Although there have been reports that large tribolites have been found in two places, east of St. Albans village and Highgate Falls village, no specimens have ever found their way into the hands of paleontologists, or reliable practical geologists The thickness of five thousand feet is very likely less than the truth; and in that great mass of stratified rocks, fossils, although rare, can be found when they are carefully explored by fossil collectors and resident stratigraphists.

In the St. Albans group, near the base, in the vicinity of the Georgia railroad station, true argillite slates are found, as at Braintree and St. Mary's bay, and there is no reasonable doubt that one day or another primordial fossils and more especially large trilobites of Paradoxidean forms will be found in the St. Albans group of Vermont, Canada and Maine. It is a question of time. But now, already, we can consider the St. Albans group as representing stratigraphically and lithologically all the lower parts of the *Paradoxides* zone containing the large *Paradoxides*, such as *Paradoxides harlani*, *Par. regina*, *Par. bennettii*, and *Par. davidis*, and also the *Holmia* zone and even the *Schmidtia* zone.

a paper on the position
ica, ("Om alderen af Olenellus zonen i Nord Amerika,"
holm, 1886) based on the erroneous classification used
adversaries of the Taconic system. If professor Brœg
not attributed several of our groups of strata to the Lov
Middle Potsdam, with which they have no relation wh
he would have come to different conclusions. His *O*
(*Holmia*) zone of Scandinavia, is well represented as he
Newfoundland. But the Georgia formation with its c
Elliptocephalus (*Olenellus*), contains all the forms of fo
the upper part of the *Paradoxides* zone of Scandinavia
the homotaxical fauna of the divisions: *a* beds with the
tus lævigatus, *c* beds with *Paradoxides forchhammeri*
beds with *Agnostus lundgeri* of Messrs. Tullberg anc
rost's classification of Scania. Several of the forms
fossils of Georgia are prophetic types and are the "ava
eurs" as Barrande says, of the forms of fossils which de
the supra-primordial fauna; such is the case with *Ol*
marcoui, *Orthisina*, *Fordilla*, *Leperditia*, *Platyceras*, an
otomaria (*Raphistoma*); no one of which is found in th
dinavian formation or *Holmia* zone. Many confusio
ed by the ever changing and always incorrect classific
the adversaries of the Taconic system, would have bee
ed by professor Brœgger, if he had not accepted a
the tables of strata published at different times by
Hall, Ford, Whitfield, Walcott and the Geological su
Canada and Newfoundland.

The synchronism between the strata of the Taconi
deposited in the Nevado-Canadian sea, and those dep
the Acadio-Russian sea, can be made only by hon
faunas and a reasonable allowance for stratigraphical p

In the province of Quebec, on the south shore of the St. Lawrence river, from Bic Harbor, Notre Dame du Portage, St. Denis, St. Roch, St. Jean, L'Islet, Canoe Island to the vicinity of Beaumont near Point Lévis, we have a fine belt of the Georgia formation or *Elliptocephalus* (*Olenellus*) zone, containing the whole fauna of Georgia, as well developed as in Vermont. As far back as 1862, in my "Letter to M. Joachim Barrande, on the Taconic rocks of Vermont and Canada," with "comparative tabular sections of the Upper Taconic rocks of Vermont and Lower Canada" p. 10, Cambridge, I have classified a group 400 feet thick, which I called "Redoute group," containing a purely primordial fauna, with the Georgia formation. In 1864, I published a very detailed plan of the lenticular masses inclosed in slates at Point Lévis ("Notice sur les gisements des lentilles trilobitifères taconiques de la Point Lévis au Canada," *Bul. Soc. Géol. France*, vol. XXI, p. 236, Paris), with a slight change, saying that " The Georgia slates have not yet been recognized with certainty in that region"; and I gave the following classification:

Quebec city group, 2,400 feet.
Point Lévis group, 1,400 feet.
Chaudière and Sillery group, 3,000 feet.

Saying at the same time, the Georgia group is probably situated between the Pointe Lévis and the Chaudière and Sillery groups. The discoveries made since by the Geological Survey of Canada of the Georgia formation with *Elliptocephalus* (*Olenellus*) *thompsoni* at L'Islet, Canoe Island and above Beaumont, in close proximity to Pointe Lévis show that my supposition was correct.

What Dr. Ells calls his Sillery group. (*Ann. Report Geol. Sur. Canada*, 1887-88, vol. III, part II, K. 1889), is composed of two divisions, the Upper and Lower Sillery. This Upper Sillery is simply the Georgia formation presenting different facies of the typical Georgia slates of Vermont, on account of an eruption of dioritic or porphyritic trap (a true diabase) in the area of La Chaudière and Etchemin rivers. In that peculiar facies the *Elliptocephalus* (*Olenellus*) *thompsoni* and other fossils of Georgia are scarce, and when no lenticular masses of limestone are found, the slates of both groups, Sillery and Pointe Lévis are confounded in one single mass of shales, red, greenish, greyish, blackish, with a few limited bands of quartzite and calcareous sandstone,

to my observations and views, what [illegible]
Sillery" represents the Georgian formation in the clos
ity of Quebec city and at Pointe Lévis, (1). Here is r
sification of the great slaty masses and limestone in th
ince of Quebec.

Tabular view of the stratigraphy of the province of Quebe

Champlain of Emmons, or true Cambrian of Sedgwick or Lower Silurian of Murchison.	UTICA SLATES, from Rouse's Point to St. John l tongues or narrow stripes resting on the Uppe slates of the Citadel Hill and Swanton group, slides along the line of contact of the Trenton Taconic slates. TRENTON, including Black River group, abo morency falls and other localities. CHAZY AND CALCIFEROUS, represented east ter passing Chico creek by a conglomerate m rolled pebbles of the underlying quartzite, se in thickness.
——————Break.	
	No Potsdam was deposited round the city o
——————Break.	
Upper Taconic or Bathyurus and Dikelocephalus zone.	CITADEL HILL AND QUEBEC CITY OR SWANTC with precursory centers of the second fauna, in lenticular masses of limestone at Quebec c Highgate spring, (Vermont.) POINT LÉVIS AND PHILLIPSBURGH; with c precursory centers of the second fauna, co lenticular masses at Pointe Lévis and at Phil
Middle Taconic or Elliptocephalus zone.	GEORGIA OR UPPER SILLERY; or *Elliptocepha lus*) belt, with *Obolella pretiosa* round Quebe *liptocephalus* eastward from near Beaumc Harbor.
Lower Taconic.	Chaudière or Lower Sillery, correspondi with the St. Albans group of Vermont.

[illegible]

the result of their joint researches, the following classification, which I résumé in a tabular view, in order to make it clear to the reader.

Cambro-Silurian of Messrs. Selwyn and Ells, or Ordovician of Mr. Walcott. The Champlain of Emmons.	LORRAINE SHALES, at St. Nicolas and St. Croix 12 miles above Pointe Lévis and Quebec city, Messrs. Giroux and Ami refer all the slates, between Charlebourg and Indian Lorette, to Ste. Foix and the Tower No.4 between "côte de la négresse and côte Sauvageau" to the Lorraine shales or true HudsonRiver sediments, with a thickness of at least 4,000 feet. No fossils are given for the area between Quebec city, Ste. Foix, Lorette and Charlebourg.
	UTICA SLATES at the mouth of the river Montmorency with *Thiarthrus beckii* common; and at the eastern side of the foot of Montmorency falls.[2]
	TRENTON LIMESTONE, at Pointe aux Trembles, Ancient Lorette, Beauport, and Montmorency, with a Black River facies in their lowest portion at Lorette and Montmorency.
	———Fault North of the city of Quebec, at the great escarpment, west of Tower No. 4.
	QUEBEC CITY ROCKS. The exact horizon of the citadel rocks is still to some extent doubtful. According to professor Lapworth, it is Lower Trenton, that is to say Black River group; and Dr. Ells calls it a peculiar development about the age of the Trenton formation.
	LÉVIS FORMATION, referred by Dr. Ells to the Lower Ordovician or Cambro-Silurian (lower Champlain of Emmons); and by Mr. Walcott to the Calciferous age.
Cambrian of Messrs. Ells and Selwyn. Lower portion of Ordovician and the Lower Cambrian of Mr. Walcott.	SILLERY FORMATION, divided into "Upper Sillery" with *Obolella pretiosa* and "Lower Sillery" by Dr. Ells, who refers both of them to the Cambrian (Taconic). Mr. Walcott includes the Upper portion of the Sillery beds in his Ordovician (Champlain) above the typical Potsdam of New York, and he is inclined to think that the Lower series of the Sillery is the source from which the "limestone conglomerate[3] of the Lévis was derived which contains the *Olenellus fauna*"

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[2] At both places the Utica slate lies in discordance of stratification on the Taconic slates of the citadel and Quebec city group. By combined erosion and denudation, a patch of lower Utica and upper Trenton has slipped over the fall, and a tongue of Utica slate has been preserved at the actual mouth of the Montmorency river in the St. Lawrence. Careful observations at Montmorency, Lorette, Quebec city, will convince every practical geologist of the occurrence of landslides in the whole area, from the moment that it become dry land or *Terra firma*,

Champlair System.	Utica Slates. Trenton. Chazy and Calciferous or quartzites conglomerate.	Cambro-Silurian.	Utica Slate. Trenton with Black River, the lower beds are made up of recemented debris from the underlying gneiss. Quebec city or Lower Trenton? Levis formation or Calciferous.		
Upper Taconic or Dikelocephalus and Bathyurus Zone.	Break. No Potsdam. Quebec City. Pointe Lévis.	No Upper Taconic, or Dikelocephalus and Bathyurus Zone.			
Middle Taconic or Ellipto-cephalus Zone.	Georgia or Upper Sillery.	Cambrian.	Sillery	Upper Sillery.	
Lower Taconic.	Chaudière or Lower Sillery.			Lower Sillery.	L

The divergences of classification are still very great, some progress has been made for the nomencla Geological survey of Canada having abandoned incomprehensible term of "Quebec group." After n tations they have come to use my nomenclature of the exception of the name Chaudière, for the princ ions of the rocks of that area; using the names of Q group, Pointe Lévis group and Sillery group; wh greater precision and a better understanding of th of strata. For the present the three preceding table cient to show how matters stand, and I shall rese

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until this day, as was proved last winter again by a landsli detailed account of the geology of the vicinity of Quebec city, for my future paper on: "The Upper Taconic of Europe and North America."

Rhode Island and Attleborough (*Massachusetts.*)—As far back as 1844, Dr. Emmons, with his extreme keeness of observation and a true prophetic sense of deduction as a practical geologist, in classifying the oldest stratified rocks, recognized his Taconic system in Rhode Island, about ten miles from Providence, saying that he found there "a fragment of the Taconic system" ("Agriculture of New York," vol. I, pp. 90-93, Albany, 1846.)

Lately Messrs. N. S. Shaler and A. F. Foerste have published a paper: "On the geology of the Cambrian district of Bristol county, Massachusetts, with description of North Attleborough fossils," in *Bull. Mus. Comp. Zool.* vol. XVI, No. 2, Cambridge, 1888, which is simply a confirmation of the old discovery and observations of Emmons. A new example among the many already signalized of the correctness and excellent views and exact classifications of the father of American palæozoic geology.

As usual with the adversaries of Dr. Emmons, who want to obliterate his record, and replace his right of priority by English nomenclature, notwithstanding the many years which have elapsed between the American and the British discoveries of primordial fossils, Messrs. Shaler and Foerste, not only have not used the national name of Taconic, but they have even neglected to quote the discovery of Emmons in Rhode Island, between Providence and Wrentham, Massachusetts, going so far as not to notice the well known reference of the stratified rocks of that little basin to the older paleozoic series. They say: "Various conjectures have been made as to the age of these deposits. They have been thought by one observer to resemble the Trias, while others, owing partly to their position, have assigned them to the Devonian age. Until I (Mr. Shaler) began my studies upon this district, the strata have afforded no fossils, and the determinations above noted were purely conjectural."

The determination of Emmons was not "purely conjectural," but based on lithology and stratigraphic position, being enclosed in a little basin of Primary rocks. The strata are formed of magnesian slates, inclosing lenticular masses of

river. Here is the list of species: 2 *Obolella*, [illegible]
Scenella, 3 *Stenotheca*, *Platyceras*, *Pleurotomaria* (*Raphi*
Hyolites, *Hyolitellus*, *Salterella*, *Aristozoe*? 2 *Microdiscus*,
ides walcottii (is not a *Paradoxides* but the small head
tocephalus asaphoides of Emmons), *Ptychoparia mu*
(is identical in every respect with *Atops trilineatus* of E
and *Ptychoparia attleborenis*.

That such a fauna, so different from the Braintre
should be placed below, by Mr. Walcott, the paleo
of the United States Geological survey, and synchroni
the *Holmia* zone or Scandinavian formation of
brook, is absolutely against all paleontological r
against all our knowledge of Taconic paleontology ("
of the Olenellus fauna, etc.," pp. 388-389, *Amer. Jr.*
XXXVII, May, 1888.)

Alleghany area.—It is probable that the Middle T
Georgia formation extends south from the eastern
the state of New York, following the eastern base of
ghanies or Appalachian mountains. Indications of
tence have been signalized many years ago in Virgi
Emmons, and more recently by others in the states o
Tennessee and Alabama.

In Texas, strata older than the Upper Taconic,
cordance of stratification under beds which contain t
primordial fauna or *Olenus* zone. But until now
have been found.

Rocky Mountain area.—The Rocky Mountain regio
es to be one of the most important fields for the st
Taconic system. The development attained by th
Lower Paleozoic strata in the Grand Cañon of the
[illegible] mountains of Utah in the Eureka

the homotaxis deposits of all the formations we know now to exist in the Acadio-Russian sea.

Arizona.—In the Grand Cañon of the Colorado, below the supra-primordial fauna beds, called the "Tonto formation,' there is in discordance of stratification, a great mass of strata of sandstone, shales and limestones, 12,000 feet thick, which until now have given very few fossils. The difficulties of search, in such ravined and almost perpendicularly cut strata, so far removed from inhabited countries, combined with the sporadic character of the appearance of fossils during the whole Taconic period, are sufficient reasons for the scarcity of the Grand Cañon primordial fossils. However, Mr. Walcott has found in a bed situated at a third of the thickness of the formation in descending order, three fossils: one Discinoid shell, an obscure *Hyolites*, and pieces of a segment of what seemed to be a trilobite—with such paleontological fragment it is impossible to synchronize with certainty, those beds with the great formations of the Middle and Lower Taconic Only we can say, that it is a first hint of the existence there of a fauna which may prove to belong to the infra-primordial fauna, and may be referred with doubt and provisionally only, to the Esthonian formation or *Schmidtia* zone. The strata containing that very small fauna of the Grand Cañon has been called "Chuar formation."

Nevada.—The Eureka district of Nevada, explored with some detail by Messrs. A. Hague and C. D. Walcott, presents a development of about 2,000 feet thick of strata belonging to the Lower and Middle Taconic. First, we have resting on the granite, the "Prospect Mountain quartzite," 1,500 feet thick, in which, until now, no fossils have been found. Being below the Georgia formation or *Elliptocephalus* (*Olenellus*) zone, as we shall see presently, those quartzites seem to represent the St. Albans group, or at least a part of it.

Directly above the quartzite there are one hundred feet of red shale, surmounted by five hundred feet of magnesian limestone. Until now the limestone has not furnished fossils: but the red shales are fossiliferous, and here is the list published by Mr. Walcott: *Olenellus* (*Elliptocephalus*) *gilberti* (1), *Ol. iddingsi*, *Olenoides quadriceps*, *Anomocare parvum*, *Ptychoparia*, *Scenella*, and *Kutorgina*. Farther up, in the magnesian limestone, in a band of shales, enclosed in the limestone, are the

U of M

taxis of the upper part of the *Paradoxides* zone of
formation of the Acadio-Russian areas.

In the Highland range, 125 miles south of Eureka, gia formation is well developed, containing the fossils: *Olenellus* (*Elliptocephalus*) *gilberti*, *Ol. iddings paria* and *Hyolites*.

East of the Highland range, at 20 miles distance, i mountains near Pioche city, is the *Elliptocephalus* (zone with fossils having a complete Georgian aspect a such as: *Elliptocephalus* (*Olenellus*) *gilberti*, *Olenoides* 2 *Crepicephalus*, *Hyolites*, *Orthis*, *Acrotreta*, *Acrothele*, and *Lingulella*. In regard to *Olenoides typicalis*, as F. Schmidt remarks in "Weitere Beiträge zu niss des *Olenellus Mickwitzi*," p. 4, St. Petersbur it is related to *Olenellus* (*Schmidtia*) *mickwitzi*, b greatly by the inferior part of the thorax below the differs also in the pygidium and the head. The *typicalis* may be considered as a degenerate form an representative of the group of the *Schmidtia*.

Farther south in Nevada, at the end of the Timpah the Georgia fauna has been found by Mr. G. K. Gilb sented by the two *Elliptocephali*, *gilberti* and *iddingsi*

Utah.—In the Wasatch mountains of Utah, at th tonwood cañon, above 11,000 feet of non-fossilifero the Georgia formation was found with its cha fauna: *Elliptocephalus* (*Olenellus*) *gilberti*, *Ptychopa ditia*, *Hyolites*, *Kutorgina* and *Lingulella*. As no been found yet, in the 11.750 feet of strata below t of the *Elliptocephalus* zone, there are strong hopes th find in that section the equivalent and homotaxical
of the Middle and Lower Taconic.

At Ophir city, in the Oquirrh range, Utah, the Georgia formation contains *Elliptocephalus* (*Olenellus*) *gilberti*, *Bathyuriscus* and *Lingulella*. And finally at Antelope Spring, in the House range, western Utah, Mr. Gilbert has recognized the Georgian fauna composed of *Agnostus*, *Olenoides*, 2 *Ptychoparia* and *Acrothele.*

British Columbia.—In the Rocky mountains of Canada, near the vicinity of the passes followed by the Canadian Pacific railroad, fifty-first parallel, the Taconic system is well developed and occupies a most important place in the stratigraphy of that region. Dr. Charles Rominger has first made known a primordial fauna, found at mount Stephens by an astronomer, Mr. O. Klotz. The fossils described by Dr. Rominger, are: *Oxygia klotzi*, *Ox. senata*, *Embolinus spinosa*, *Emb. rotunda*, *Monocephalus salteri?* *Conocephalites cordilleræ*, *Bathyurus?* *Agnostus*, *Hyolites*, *Orthis?* *Kutorgina*, *Metoptoma* and *Obolella*. ("Description of Primordial fossils from Mount Stephens, N. W. Territory of Canada," in *Proceed. Acad. Nat. Sc. Philadelphia*, 1887, pp. 12-19.)

Mr. R. G. McConnell has published in the "Annual Report of the Geological Survey of Canada for 1886," a description with an important section of the Castle Mountain group. He has found fossils at two different horizons; the lowest one indicates the *Elliptocephalus* (*Olenellus*) zone with an *Elliptocephalus* (*Olenellus?*), a *Ptychoparia*, and a *Protypus*. That small fauna rests on 10,000 feet of a series of dark colored argillites and sandstone, in which no fossils have been found yet; but which very likely may prove to represent the lower group of the Middle Taconic and Lower Taconic, just like the St. Albans group of Vermont and the lower great series of Cottonwood cañon in Utah, and the Grand Cañon of the Colorado.

Above the horizon of the *Olenellus?* (*Elliptocephalus*), at a distance estimated at 2,000 feet, Mr. McConnell has found the fauna described by Dr. Rominger, which seems to indicate for the Georgia formation of British Columbia a thickness four or five times greater than at the typical locality of Georgia, Vermont. But in such grouping of strata, in great dislocated masses of slate, it is impossible to give very exact measurements for the different formations; and we may regard the two horizons of fossils at mount Stephens, in the Castle Mountain

STUDIES ON MONTICULIPORA.

By Dr. C. Rominger, Ann Arbor.

This group of paleozoic fossils, very prolific in nu
forms, familiar to every paleontologist in a genera
nevertheless remained very imperfectly known unti
comparatively recent time, when the microscopic
investigation began to be adopted by paleontologists
those who contributed to a more accurate knowle
Monticulipora tribe Prof. Alleyne Nicholson was
foremost. His first publication on this subject, ma
of the geological reports of the State of Ohio, is bas
amination of specimens, found in the Hudson Rive
the environs of Cincinnati, conducted according t
customary method, restricting itself to observation
characters, visible with the naked eye, or assisted
of an ordinary lens. Mr. Nicholson himse
this part of his work to be merely a preliminary fir
to arrange the numerous differentiated forms b
within certain definite specific limits. In a second p
entitled "*On the Structure of the Tabulate Corals,*"
are derived to a great extent from the microscopica
tion of thin sections, whereby a number of char
closed themselves to him which previously had
notice, and which in many instances demanded n
important changes of his formerly expressed vi
subsequent continuance of these microscopical ol
constantly adding new facts, involved for him the
many other progressive modifications of his view
laid down in his last publication "*On the Structure*
ties of the genus Monticulipora." Therefore passing

About the same time that Mr. Nicolson's publications appeared Mr. E. O. Ulrich, of Cincinnati, took up the study of the monticuliporoid family as a specialty and made the results of his labors known through a succession of essays appearing in the Journal of the Cincinnati Society of Natural History. Later, in the fourteenth annual report of the Geological Survey of Minnesota, he gives descriptions of quite numerous representatives of this group, and just recently, his contributions to micropaleontology of the Cambro-silurian rocks, came out as a part of the geological reports of Canada. We are also promised by him an explicit treatise on Bryozoa in the eighth volume of the Geological Survey of Illinois, not yet printed. The different publications of Mr. Ulrich give creditable testimony of his zeal and his ability in making observations, but it is to be regretted to see him attribute to every trifling modification he observes in these structures an undue importance which induces him to propose on the strength of these, a fabulous number of generic and specific distinctions, which, instead of helping the reader to a quick and clear perception of the typical features of the very numerous representatives of this group, inundate his mind and memory with a flood of vague definitions which is bewildering and repulsive.

As I had always felt a particular interest in the study of this same group of fossils and had published, twenty-five years past, a small essay, entitled "On the Structure of Chætetes and Related Forms" in the proceedings of the Academy of Natural Sciences of Philadelphia (1866), I take the occasion now to communicate the results of continued studies in this direction, which filled out a good many of my leisure hours during later intervals, by passing a critical review over the works of the two mentioned writers, whereby opportunity offers itself to corroborate many of their observations, and on the other hand, points of disagreement in observations, or in conclusions based on such, can be most conveniently argued.

In the first chapter of his work on *Monticulipora* Mr. Nicholson explicitly discusses the general history of the genus *Monticulipora* and hereby gives expression to the views entertained by himself. A second chapter treats on the general and comparative structure of *Monticulipora*, which genus in its wider sense he defines as "Forms in which the corallum is composed of numerous closely approximated tubular corallites, the

horizontal; sometimes in a peculiarly [illegible]
complete." Corallites usually divisible into two distii
one of large, the the other of small tubes; the l
usually, but not always, more closely tabulated
larger tubes, or showing other peculiarities of
Surface often, but not always, exhibiting at regula
definite areas which are occupied by corallites whicl
larger or smaller than the average. These area
elevated above the general surface, when they
monticules, or they may be level with the surface
depressed below it, when they are called "*maculæ*."
goes on to describe the form of the corallum, as bein
ly variable, though often constant for the same sp
distinguishes a massive, a discoid, dendroid, l
frondescent and an encrusting mode of growth, whe
particularly in the dendroid forms, an obvious diff
of the corallum into an axial and peripheral re
In the axial region the corallites are generally
and angular, often with few tabulæ. On the othe
the peripheral region the corallites are often th
commonly rounded, and usually with many tabul
the statement is made that interstitial tubular
called spiniform corallites, if present, are most ger
fined to this peripheral region. This differentia
axial and peripheral region is less developed in fo
sive or discoid mode of growth. Considering tl
of the tube walls of Monticulipora Mr. Nicholsor
the general duplicity of the walls of contiguous
in certain forms is permanently preserved, as for
M. trentonensis, *M. jamesi* and others. In other
[illegible] etc. the walls are

walls are merely indicated by an intermediate lurid space without a line of demarkation. Finally he mentions *M. andrewsii*, *M. gracilis*, *M. moniliformis* as examples which exhibit an amalgamation of the adjoining walls to such an extent that the substance intermediate between the visceral cavities appears as a homogeneous mass of high-colored sclerenchyma, barely showing in the neighborhood of the actual tube cavities some fine concentric lines of deposition. These enumerated modifications in the wall structure are to my conceptions not the exponents of a real difference in their organization, but merely specific variations of the same structural type.

The superimposed obliquely ascending layers of sclerenchyma, well represented in fig 3, page 40, of Mr. Nicholson's work, are, in my opinion, not a structural peculiarity, confined to the terminal part of the tube-walls, but the entire tubes, from base to top, are built of a succession of similarly superimposed oblique layers, which unite in an arch or under a more or less acute angle with similar layers of the adjoining tubes. No part of the wall is structureless, as Mr. Nicholson expresses it, but I admit that the mode of preservation and the delicacy of the tube-walls often obscures the traces of structure. The mentioned succession of obliquely superimposed sclerenchym layers not only builds up the outer walls of the tubes, but all the tabulæ intersecting the tube cavities are a direct continuation of such layers, periodically spread across the channel and constituting then a regular cup. It is the same process of growth that builds up the calyx of a cup coral with its transverse tabulæ, but I am far from suggesting a relationship; my inference is only to show how nature often uses the same means in the accomplishment of organic structures of altogether different affinities.

A very common superficial character of Monticulipora and allied forms is the occurrence of numerous nodular or spire-like projections, located in the circumference of the tube orifices and on the angles of junction between the tubes. Among the specimens described by Milne Edwards from the strata of Cincinnati, he observed in one of the kinds, numerous stout spinules disseminated over the surface and considered this to be a character of sufficient importance to distinguish that form from the associated Monticuliporas as a peculiar generic type, under the name "*Dekaya*," which dis-

on the ground that an overwhelming majority of
comprised under the name *Monticulipora*, is pro
similar spinulose prominences, and that in the st
the so-called *Dekaya* no other peculiarity can be po
in which it differs from *Monticulipora* proper. I
also, that these spinules were of subordinate functio
as in the same specimens a portion of the surface m
spinules, while in another none are observable.

Mr. Nicholson is inclined to attribute to these
prominences a greater physiological importance, b
ing them with the ordinary corallites, as being a
modified form of Zooide, which he designates by t
"Spiniform Corallites," and describes as blunt, u
perforate projections, in which he exceptionally c
times discover an apical aperture. From the app
these spines in thin sections, their composition of
laminæ of sclerenchyma, with a dark, or a clear luc
the center, leaves no doubt in him, that these str
primitively hollow, and represent a peculiar mod
corallites, whose cavity becomes in progress of gr
up with a secondary deposit of sclerenchyma.

I have examined several hundreds of sections of
pora specimens provided with spinules, and admit
ness of Mr. Nicholson's observations, that these
resemble, in tangential as well as in longitudin
tubules with very thick concentrically laminated
that in some instances even an actual central can
exist, usually, however, the center of these spinu
originally so, and not as Mr. Nicholson thinks, by
process of deposition, replenished with sclerench
The lucid central portion of the spinules, suppo

as has been incidentally described before, built up by a succession of delicate layers, directed from below, upward and outward. Periodically their cavity is intersected by transverse diaphragms, which likewise are an extension of such layers across the tube-channel, in which case the deposited layers form a closed cup, and the whole length of the tube may be considered a succession of similar cups, one invaginated into the other and open toward the periphery. The structure of the spinules, with regard to their supposed central cavity, is just inverted; their lamination, in perfect accordance with the lamination of the ordinary tubules, holds an ascending anticlinal position toward their central canal and forms a series of invaginated cups closed at the apex and not in the bottom, which excludes the possibility of a central channel, opening on the surface, like the other tubules. To my conception the spinules are an integrant part of the ordinary tube-walls, whose margins, by exuberance in secretion of shell matter, form nodular prominences in certain spots of their circumference, which, amalgamating with similar prominences of the adjoining tube-walls, contribute the spinules. On the line of junction between these joining walls, usually an uninterrupted continuation of the laminæ, from one side of these conical prominences to the other, can be observed, but sometimes on this line, by incomplete amalgamation of the ends of the anticlinal layers a central vacant space is left which resembles the channel of a tube, but the physiological functions of such merely occasionally developed tubular spaces, are not comparable with those of the ordinary tubes, which are the domicile of an organism secreting this calcareous structure, in layers conforming to the shape of its body. The channels, perforating exceptionally the center of the spinules, have no walls of their own; they are surrounded by the walls of neighboring tubes, whose structural channels hold an anticlinal position toward the cavities of the spinules, which structure is a positive proof that these channels cannot be a specific modification of tubular Zoœcia, or else they would be enclosed by independent walls, of the make of the inhabiting Zooidia, which walls would hold necessarily a synclinal and not an anticlinal position of their lamination toward the cavity, as the case is. The occurrence of spinules is generally restricted to the peripheral ends of the tubes, they form columnar, incrassated,

appears in vertical sections through the [illegible]
of beads, stringed together, instead of presenting cc
columns as in *Monticulipora*.

It may be of interest if I remark on this occasio
none of Silurian, Devonian or lower Subcarboniferou
culiporoids this beaded appearance occurred to me
specimens from the Chester group and from the
strata of the Coal Measures, all exhibit this beaded ap
and besides have a large central perforation of
phragms, which, according to Nicholson, is another
character of *Stenopora*. A third characteristic f
Stenopora mentioned by Prof. Nicholson, a perfc
the tubes by connecting pore-channels, I have not
to recognize in any single instance, although some
amined specimens were so favorably preserved tl
perforations existed they could not have escaped m
tion.

The previous expositions regarding the occur
structure of the spinules in *Monticulipora* are not v
ble for the sustenance of Mr. Nicholson's sugges
these structures have a functional analogy with th
tubes and deserve therefore to be designated as '
corallites." I may be equally at fault, considerin
gans as merely ornamental, because I know nothi
about their vital functions; but the circumstance tl
of one and the same specimen spinules are often
developed, while in other parts of the surface they
missing, or only thinly scattered, seems to me a
indication that their functional importance can
great, and at all events not essential for the vital

tial sections from four to seven of these can be seen encircling the lumen of the tubes, not all of them stand on the same level, nor in longitudinal rows, but they are scattered singly all over the inner cavity without apparent order. Similar spinules I found in great numbers covering the inner surface of the tubes of a *Monticulipora* or *Stenopora* from the Chester group of Arkansas. With reference to *Mont. moniliformis* I have to state yet the perfect independence of the inner horizontally projecting spinules, from the much larger ones, vertically projecting above the angles of junction between the tubes. The discovery of spinules covering the inner surface of the tube-channels in a few species of *Monticulipora* and their absence in the majority of other species, while it proves a wider distribution of this structural character than previously was known, the restriction of the appendages to a few species only, demonstrates at the same time, that their functional value cannot be very great, no more than a specific peculiarity, of the same order, as the more generally developed superficial spinules. Proceeding with the chapter on the comparative structure of *Monticulipora*, Mr. Nicholson describes the corallum of *Monticulipora* as being generally dimorphic, explaining, that he does not follow the current opinion regarding the minute tubules, interstitial between the larger ones, as young corallites, or as cœnenchymal tubuli, but referring to Mr. Moseley's researches on the living *Heliopora*, he feels himself thoroughly satisfied that in *Monticulipora* a similar dimorphism exists to that in *Heliopora*, and that the different sets of tubes in *Monticulipora* are inhabited by different sets of Zooids. He admits, however, that there are forms of Monticulipora resembling the dimorphic species, in which all of the corallites of the colony are apparently similar in their internal structure and approximately equal in size, of which he hesitates to assert positively their dimorphism.

Discussing the nature of the tabulæ, the form and arrangement of these structures in different corallites of the colony, Mr. Nicholson goes on to state that they are never wholly absent in any form of *Monticulipora*, but sometimes entirely wanting in portions of the corallum. That the tabulæ are in the majority of monticliporoids "complete" horizontal or curved, but that in other forms a peculiar incompleteness of the tabulæ occurs, whereby an excentric or sometimes subcentral

side of them, which usually
by straight diaphragms extending from the vesi
opposite free portion of the side walls. Occasi
incomplete tabulæ have also the shape of short-tr
one invaginated into the other. The set of sm
usually developed in the forms with incomplete
in distinction from the large tubes always int
closely approximated and complete straight
Concerning the occurrence of longitudinal septa
tubules of *Monticulipora* Mr. Nicholson with propri
that nothing of septa, in the proper sense of th
ever been detected. The indentation of the orifice
observable in certain spinulose forms of *Mont*
caused by a merely accidental projection of spinu
orifices, whose outer margins they occupy, and
comparable with the radiation of septate coral
spinules which I discovered in the tube-cavities
pora moniliformis Nicholson, and in another C
species not yet named, are no exception to this
have no analogy with radial septa.

In the third chapter of his book Mr. Nicholson
opinion on Prof. Lindstroem's views, who thinks
to be only a certain stage in the developement o
ella or *Ceramopora*, passing first through a trans
pora stadium, and finally in its full developement
a *Monticulipora*. This totally erroneous conceptio
ed by Mr. Nicholson as in direct opposition with h
vations, and I fully concur in this repudiation
cause observations on American specimens prov
pendence of these 3 generic types, but also becau
I received from Mr. Lindstroem, to demonstrate

jecting into their tube cavities appear to Mr. Nicholson differences of sufficient import to abrogate a real close affinity between the two genera. The occurrence of spinules within the tubes of certain species of *Monticulipora*, which is stated by me previously, invalidates one of the supposed principal characters of differentiation, but notwithstanding this, I concur in in Mr. Nicholson's opinion, believing, that the perforated structure of the inseparably united tube walls of *Heteropora* not differing in any way from the smaller interstitial tubules, is for itself alone, a difference, derogatory to a very close relationship between *Monticulipora* and *Heteropora*, but I still believe that *Monticulipora* stands in its general organization nearer the Bryozoa than the Alcyonaria, which latter are regarded by Mr. Nicholson as the group to which *Monticulipora* belongs.

In chapter IV, the relations of *Monticulipora* to *Chætetes*, *Stenopora*, *Tetradium* *Ceramopora* and *Heterodictya* are expounded in a mode, which in a general way meets my approbation. *Chætetes* is defined, as composed of inseparably united tubules of one kind only, which multiply by division, instead of lateral gemmation, as *Monticulipora* exhibits it; these forms first appear during the Carboniferous period. Another form, beginning at the same period, is *Stenopora* Lonsdale, redefined by Mr. Nicholson, as resembling a typical ramose *Monticulipora*, whose tubules in the peripheral area of the stems undergo a process of incrassation, with periodical interruptions, while in *Monticulipora* this process of thickness went on uniformly. This periodicity in the accretion gives the walls of *Stenopora* an annulated appearance like a string of beads. A further peculiarity of *Stenopora* is found in the structure of its diaphragms, which in part being complete and flat, exhibit in another portion a large sub-central perforation with a thickened slightly deflected rim round this opening. A third generic feature, ascribed by Mr. Nicholson to *Stenopora*, is very questionable in its reality; this is a perforation of the tube walls by communicating pores as in *Favosites*. In his statements he relies on specimens of *Stenopora jackii* from Australia in which he claims to have discovered the unmistakeable existence of such pores, while on the other hand he admits his failure to discover similar pores in other species of *Stenopora* which came under his observation. In a number of specimens found in the Chester group of the Mississippi valley and in the

earnest doubts whether any species of *Stenopora* is
with such channels of communication.

In the further progress of comparisons the gene
blance of *Tetradium* to the massive forms of *Monti*
mentioned, but considering the structure of the first
arably united tubules of one kind only, which exhil
to 4 inflexions of their walls, which project into the
prominent longitudinal septa, besides a different ch
the transverse tabulation, Mr. Nicholson comes to
priate conclusion, that there exists no closer relati
tween the two genera.

Comparing *Ceramopora* with *Monticulipora* he re
much closer affinity, but considers the generally ob
tion of the tube orifices to the surface in *Ceramopo*
projecting rim surrounding them, besides a differ
nature of the interstitial cell spaces of the compare
peculiarities of sufficient import to separate them a
ly distinct.

A fifth chapter is devoted to an attempt of sul
Monticulipora in its wider sense, into subordinate
from a standpoint of practical expediency he di
from *Monticulipora* in a more restricted sense, the g
lipora and *Constellaria*, and *Dekaya*, although he ac
close relationship between them and *Monticulipora*
then correctly points out the differences between
and *Monticulipora*, but I believe commits an error
ing *Fistulipora* with *Callopora* of Hall, the type for
is *Callopora elegantula*. The interstitial cells of this
have always the shape of cloudy tabulated coni
intercalated between the peripheral portions of the
[illegible] enlarged in the central portions of th

spaces are much more numerous and take part in the constitution of the corallum throughout its entire mass; moreover these interstitial cells never have the form of gradually enlarging conical, closely tabulated tubules, but are arranged in superimposed vesicular layers with laterally interlocking vesicules incompatible with the presence of a common wall inclosing the superimposed cellspaces of very unequal dimensions.

Mr. Nicholson aware of this fact, draws a comparison between *Heliolites* and *Propora* which differ among themselves in a similar manner, one having an obviously tubular interstitial tissue, the other presenting like *Fistulipora*, layers of interlocking vesicules As this comparison implicitly admits an equal difference between *Fistulipora* and *Callopora*, as we observe it in *Heliolites* and *Propora*, it follows that Mr. Nicholson acknowledges to *Callopora* the same typical independence as exists between *Heliolites* and *Propora*, *Syellia*. On this occasion I feel induced to remark that the above comparison strikingly illustrates how nature repeated its structural designs in widely different organisms in almost exactly the same manner. *Constellaria* Dana, is by Mr. Nicholson considered as synonym with *Stellipora* Hall. Mr. Ulrich thinks the two differ essentially. As I have never seen an authentic specimen of *Stellipora*, I can give no definite opinion, but it appears to me, that an identification of the Hudson River group fossil with the form described by Hall as *Stellipora antheloidea* is not justified by the figures given by Hall, and also his description of the unique specimen, does not apply to *Constellaria* of the Hudson River group.

In the above mentioned essay, published by me in 1866, I had from the external appearance of *Constellaria*, which in many respects resembles *Fistulipora*, inferred their generic identy, and also Mr. Nicholson considers them so closely related that he is in doubt whether a generic separation of the two is advisable. Examination of thin sections, however, has since fully convinced me, that except this external similarity, there is little resemblance in the structure of *Constellaria* and *Fistulipora*. In the latter, the interstitial vesicules are equally developed through the entire corallum and form an interlocking continuous plasma, into which the larger tubules are immersed. In *Constellaria* the interstitial cells are confined to the peripheral crusts of the stems, whose interior is exclusively formed

The genus *Dekaya* of [illegible]
Mr. Nicholson with the remark that its distinction
iferous species of *Monticulipora* is merely an arbitr
which the species can be conveniently distinguished
apart, but in reality such distinction is an endless
confusion. The great majority of all Monticulipor
vided with spinules and a distinction of forms with
more distant spinules from those with smaller
vague as the difference between large and small, wi
ing a defined standard of magnitude for compariso
other hand are those spinulose prominences in
forms, provided with them, equally developed; som
of a stem may be conspicuously ornamented with
another part of of it does not exhibit any. I reject
the acceptance of *Dekaya* as being an obnoxious ba
science.

Monticulipora, in its restrictive sense, is defin
Nicholson as: "Coralla composed of tubular coral
are mostly of two kinds, differing from one anothe
size and also in their tabulation. The small co
never so greatly developed as to entirely isolat
tubes except in an occasional corallite, nor do the
shaped elevated monticules. The tabulæ of the s
lites never become vesiculose, nor are even their
erated. Spiniform corallites commonly presen
project above the surface as blunt spines, but they
conspicuous surface columns."

The genus as above defined includes a large num
exhibiting great variations in internal structure.
olson therefore provisionally proposes a sub-div
framed genus in a number of subgenera. Thes

ened towards their mouths, while they usually possess few and remote tabulæ. These corallites are to some extent contiguous, but always partially separated by the corallites of the smaller series, which are also subangular or rounded and more or less thickened towards their mouths. In all the corallites the tabulæ are complete and the small tubules are more closely tabulate than the larger ones. Spiniform corallites are often very well developed, but at other times are few or wanting.

As the type of Heterotrypa Mr. Nicholson selected *Mont. mammulata* of D'Orbigny, but the form described by him under that name, is in my opinion, and the opinion of the plurality of paleontologists, not the form so named by D'Orbigny; it is *Mont. frondosa* of D'Orbigny, which latter name Mr. Nicholson applies to another form described by me under the name *Mont. decipiens*, and the name *M. mammulata* actually belongs to a form to which Mr. Nicholson gave the name *Mont. molesta*. As additional representatives of the subgenus *Heterotrypa* he mentions "*Het. ulrichi*, *H. gracilis*, *H. andrewsii*, *H. ramosa*, *rugosa*, and its varieties, *approximata*. and *dalei*; besides *H. moniliformis*, *subpulchella*, *o'nealli*, *nodulosa jamesii*, *implicata*, *girvanensis*, *trentonensis* and *dawsoni*."

With the exception of *M. rugosa*, *ramosa* and *dalei*, all other enumerated species are new, defined and named by Mr. Nicholson himself..

The forms grouped together under the subgenus *Heterotrypa* are not all closely related in the type-form, (Nicholson's *mammulata*). In *H. frondosa*, besides *H. subpulchella*. *H. ulrichi*, *H. trentonensis*. *H. dawsoni*, the dimorphism of the corallites notably differs from the dimorphic structure exhibited by *H. rugosa*. *ramosa*. *o'nealli*, *gracilis*, etc. In the latter the smaller interstitial tubules retain along their whole extent about the same diameter, and are much more closely septate than the ordinary larger corallites, so that this structural difference obviously is to be taken as representing a difference in function, while on the other hand the previously enumerated species exhibit in the structure of their interstitial tubules no great departure from that of the ordinary tubes; they rapidly dilate in the course of their growth and their diaphragms with this enlargement *pari passu* become more distant and finally we can, at least in a part of them, observe their direct

The subgenus *Diplotrypa* is intended to embrace of hemispherical growth, with obviously distinct sets and smaller tubules, which latter are much more sep the larger ones and are uniformly developed throug corrallum from its basal commencement to the uppe There is also no thickening of the tube walls obse they approach the periphery, but this is not a typi liarity for *Diplotrypa*, but in all other forms of *Mont* which grow in globular or hemispherical masses, the not appreciably thicken towards their peripheral e the contrary all Monticuliporas of ramose growt much more thick-walled near the surface than they central parts of the stems.

The subgenus *Prasopora* perfectly corresponds wi *trypa* in mode of growth, the only difference betwee is, the development of incomplete vesiculose di aside of ordinary complete tabulæ in *Prasapo* in *Diplotrypa* only complete transverse tabulæ no vesicular ones. As in many instances the dev of vesicular incomplete diaphragms occassional where as a rule only complete ones are observed, a versely specimens of typical *Prasopora* exhibit n part of their larger tubes intersected by complete tabulæ only, with almost total exclusion of the i vesicular kind, in such case the structure of the c absolutely identical with that of *Diplotrypa*, and as t ment of vesicular diaphragms is an invariably const ural feature of *Prasopora* in all the specimens or specimens, I am of the opinion it would be better *Diplotrypa* altogether and subordinate the forms co also that the mode of growth in *Peronopora* is either laminar or incrusting, but there is besides a number of species of truly ramose growth, which harmonize in general structure with *Peronopora*. Among these I mention the forms which Mr. Ulrich has described under the name of *Homotrypa*, and which do not seem to have come under the observation of Mr. Nicholson. It has been remarked on a previous occasion that in all species of *Monticulipora* growing in hemispherical or subglobular form whatever other specified peculiarities they may have, the tubes are not subject to an incrassation as they approach the surface and on the other side, that invariably, with the ramose growth, a thickening of the tube walls near the surface is coincident; considered from this standpoint the whole difference between *Prasopora* and *Peronopora* rests on a difference in the mode of growth.

The fifth subgenus *Monotrypa*, comprises the forms whose tubules show no dimorphism,but are all of one kind. Some of these, located on or around the monticules, or in corresponding not elevate spots, are of somewhat larger size than the remainder, but they otherwise do not differ in structure from the smaller ones. Usually a few small angular cell openings are observable between the orifices of the ordinary tubes, but in sections it becomes evident that also these are only young tubules orignating by lateral gemmation from the older ones.

Certain species as for instance *M. moniliformis* are by Mr. Nicholson arranged under the genus *Heterotrypa*, but according to their structure their appropriate place is with *Monotrypa*.

These subdivisions of *Monticulipora*, considered as an expediency for general orientation, concerning the developement of certain structural characters, peculiar to a group of certain species and not, or not so well, developed in others, I find appropriate, but the division lines drawn by Mr. Nicholson between these groups,are no more than an artificial arrangement, placing the principal weight on a certain structural character in one instance, and in another on some other character, whereby frequently forms otherwise not closely related on account of the conspicuity of this one character, are assembled into one group, and on the other hand, closely related forms differing only in that one special point, are for such reason severed and disposed of in different groups.

As it regards the establishment of the precise limits of cer-

which do not exist (for example the pores connectin
of his *Homotrypa*), but comparing the work of the t
Mr. Nicholson's method of doing his work is far pr
Mr. Ulrich's. The first strives to give his scientific c
tions in the shortest possible condensation, the sec
out with pompous display as a radical reformer. C
side he parades on every possible occasion with the
evolution theory, speaks of the ancestry and derivat
tain forms, of prophetic types, and of analogies quit
in reality, still in total contradiction with the evolut
He tries to potentiate the most trifling differences in
ture of the examined fossils to a magnitude which
patible with specific or generic identity; and then,
such widely differing typeforms must have names,
generic, with Mr. Ulrich's signature behind them. Fun
Mr. Ulrich sometimes seems to feel himself embarr
the too prolific crop of his genera, for instance on
while defining the genus *Atactoporella* he says, "*the
differs from Atactopora, in having numerous closely t
terstitial cells, cystoid diaphragms in the proper zooci
instead of thick walls.*" Now comes the self-conso
"*These are all good generic characters,*" etc., which e
my mind raises the suspicion that Mr. Ulrich was
sure whether the three mentioned characters real
such valuation.

To enter into a special critical review of the pr
tematical schemes of Mr. Ulrich would be a tedio
extend the bulk of this essay far beyond its inte
Many of these eccentricities will soon fall into ol
out contradiction, but in justification of this su

D'Orby, which in Mr. Nicholson is a *Peronopora*, and by nine other species of his own make, four of which are not yet described.

2. *Heterotrypa* Nichols. is acknowledged, but of the seventeen species Nicholson places under this group, but two are in Mr. Ulrich's opinion, representing the genus; among these, however, he adds to the two, several other species described by himself.

3. *Diplotrypa* Nicholson is taken as valid.

4. *Monotrypa* Nicholson likewise, but only *Monotrypa undulata* is a true representation. *M. quadrata* and some other forms described by himself are

5. *Monotrypella* Ulrich.

6. *Prasopora* Nicholson is enriched by a number of new species of Mr. Ulrich's.

7. *Peronopora* Nicholson likewise receives a number of new representatives.

8. *Homotrypa* Ulrich are specimens of ramose growth very similar in structure to *Peronopora*.

9. *Homotrypella* Ulrich differs from No. 8 by more abundant interstitial cells.

10. *Stenopora* Lonsdale redefined by Nicholson is accepted.

11. *Callopora* Hall according to Ulrich embraces also the forms like *M rugosa*, *M. ramosa*, *M. dalei* M. Edw. *M. andrewsii* Nichols., *M. o'nealli* Nicholson, which association also in my own opinion is supported by a very close similarity in the structure of these forms.

12. *Calloporella* Ulr. grows in thin expansion in distinction from the ramose form of *Callopora*.

13. *Amplexopora* Ulrich is designed for several species described by Ulrich, but embraces also Nicholson's species *Hetcrop. moniliformis*, *barrandii*, *M. discoidea* Nich. and others.

14. *Batostoma* Ulrich is represented by *Heterotr. jamesii* Nich. and by *H. implicata* besides various of Mr. Ulrich's own species.

15. ***Batosomella*** represented by *Heterotr. gracilis* Nicholson besides several new species of Mr. Ulrich. On comparison with the description of Batostoma with the one given of itself, only differs from the former by the remark "Cell apertures small."

16. *Leioclema* Ulrich, enumerated by him among the monticuliporoids, is the form described by Hall under the name

ular indented form.

18. *Atactoporella* similar to the former, but di
numerous interstitial cells and by vesicular diaphra
are said to be simply straight in the former.

19. *Dekaya* Edw. & H. is accepted.

20. *Dekayella* Ulrich are similarly spinulose forms
erous interstitial cells.

21. *Nebulipora* M'Coy is accepted.

22. *Aspidopora* Ulrich are small convexo-concave
covered by an epitheca on the lower side, structure c
ing with other forms of *Monticulipora* of dimorphou
with abundant interstitial cells and spinules on the
junction of the tubes.

23. *Discotrypa* Ulrich of similar growth to the f
destitute of spinules and interstitial cells.

24. *Petigopora* Ulrich. *Chætetes petechialis* Nichols
parasitic cumuli of *Monticulipora* structure without
cells but numerous stout spinules projecting from
of junction.

25. *Leptotrypa* Ulrich incrusting forms with t
polygonal tubes without interstitial tubes but pro
spinules situated on the angles of junction. Besi
newly described species. Mr. Ulrich places here
discoideus James, *Mont. calceola* Miller and *Mont.*
James.

26. *Spatiopora* Ulrich, thin incrusting expansi
Monticulipora type with short shallow tubules, an
interstitial ones, smooth or strongly tuberculated
ornamented with spinules of considerable size.

Endeavoring to impress my mind with the di
features of the long series of the just enumerate

come too rapid, the single spokes soon were no more discernible, I could see a quivering disk only, and everything around me began to rotate, then a prostrating giddiness overcame me, cold drops of sweat ran down over my temples, and in this dreadful agony, near to fainting, I fortunately could recollect an old popular German remedy, very efficacious in similar cases of ailings; it is, "the invocation of Sanctus Ulricus," accidentally a namesake of the author; I did so, and it was not in vain, I felt instantaneous relief after the invocation, but vowed, never to attempt a similar experiment, even on the risk of being deprived forever of the pleasure of fully comprehending Mr. Ulrich's interpretations of creation. Trusting in Mr. Ulrich's pronounced taste for eccentricities, I have committed one myself hoping some success from a humorous attack on his method of making natural history. I should be very sorry if he took it as meaning personal offense, I have wished only to open his eyes, to see, how little good he can do by wasting his ingenuity the way he does, and how much more he would benefit science and himself if he contented himself to communicate the results of his assiduous labors in the simplest possible manner, and with a perspicuity allowing to see every detail; but before all sketching with conspicuous outlines the structural characters, proving a harmonious unity of design in the organization of all these natural objects to which the present discussion has reference.

REVIEW OF RECENT GEOLOGICAL LITERATURE,

The Cretaceous and Teritary Geology of the Sergipe-Alagoas Basin of Brazil. By JOHN C. BRANNER. (Trans. Amer. Phil. Soc. Philada; vol. xvi, part 3, 1890; p. 369-434.) This study of Cretaceous and Teritary geology of a portion of Brazil forms an important addition to geological literature. Prof. Branner examined this region in 1875-1876 and according to his statements, the publication of the results was deferred in order that the Brazilian Government might publish the results, which however was never done, and Prof. Branner prepared a paper, which was read before the Philosophical Society, Sept. 7th, 1888. The author is very much impressed with the geological importance of this region and the results brought out later tend to prove this assertion. Their importance consists in the great range of deposits, the very rich fossiliferous beds and the "accessibility of good exposures across the entire section."

ternary and recent
unusually abundant. "The Stratigraphical Relations of and
tions attending the deposition of, the Mesozoic beds" are th
The beautiful oölitic limstones of the Rio Sergipe will, ac
Prof. Branner, no doubt be extensively utilized in the near
architectural purposes. Part ii. "The Brazilian Mesozoic Ba
than that of Segipe-Alagoas." In this part are described th
ous beds of Sao Francisco do Sul, Bahia basin and Pernambu
part is concluded with "Correlation of the Mesozoic of the
the interior." Part iii. The Teritary Geology. Two notewo
ures of this Tertiary are the uniformity in the general chara
beds and the almost entire absence of fossils. Two hypo
offered for the latter: That these rocks were deposited so r
with water so overloaded with sediments, that animal life w
sible, or that these beds once held organic remains, but tha
been dissolved out by infiltrating waters. Part iv, is a bibl
some sixty-five titles. From the paper now before us it is e
this region presents unusual advantages for a study, both
and palæontological and it is to be regretted that the au
paper has been unable to continue his investigations, so a
begun.

Gems and Precious Stones. By GEORGE FREDERICK KUN
Scientific Publishing Co., New York, 1890. Undoubtedl
artistic book of the year and of a nature both popular an
is Mr. Kunz's present work. No one is better fitted to writ
important subject than Mr. Kunz. His great experience
and precious stones in all conditions makes this present
inestimable value. The subject is treated in a manner wh
both to the scientific and the general reader and in every li
himself delighted. Naturally enough the diamond is first
then all the other minerals which have been or could be u
are successively described. The author deserves great cr
manner in which the book appears and the beautifully exe
by Messrs. Prang & Co. add much to the value of this sur
ume.

particularly interesting,) two Leptodesma, and six Platyceras; from the Clinton one new Orthis, Rhynchonella, Modiolopsis, Nucula, and two Tellinomya; from the Lower Helderberg one Chonetes, Acervularia and Cladopora; Waverly, one Syringothyris and two Rhynchonella; Homalonotus trentonensis Simp. n. sp. from the strata of the Trenton group near Reedsville, Mifflin Co., Pa.

Catalogue of Minerals for sale by George L. English & Co., Philadelphia and New York 15th edition, 1890, pp. 100.

This is undoubtedly the most comprehensive catalogue of minerals so far issued in this country, the work not only containing the trade catalogue but also a large amount of much useful information concerning many new minerals lately described, forty pages being devoted to descriptions of beryllonite, jarosite, lettsomite, phenacite, bertrandite, sperrylite, etc., all indicating the valuable character of the material this firm offers to the public.

In the price list Danna's classification is used, beginning with the native elements, sulphides, etc. Then follows an alphabetical list of new species and varieties (brought up to date of publication) which is undoubtedly one of the most valuable features of the book, which is then concluded with an index of all the species.

Messrs. English & Co. deserve great credit for this beautiful publication. It is well and neatly illustrated and very handsomely bound.

First Annual Report of the Geological Survey of Texas, 1889. E. T. DUMBLE, State Geologist, Austin: Royal octavo, xc. and 410 pp., with maps.

This fine volume embraces a general report by Mr. Dumble on the organization of the survey and on the preliminary classification of the Texas formations, and several accompanying papers, viz: By R. A. F. Penrose Jr. on the gulf Tertiary of Texas, by Robt. T. Hill on the Cretaceous rocks of Texas and their economic uses, by W. F. Cummins on the southern border of the central coal field, and on the Permian of Texas and its overlying beds, by Ralph S. Tarr on the coal fields of the Colorado river, by Streeruwitz on the geology of Trans-Pecos Texas, and by Theo. B. Comstock on the central mineral region of Texas.

The report of Mr. Comstock shows that in the Archæan in Texas, there are probably three series or systems of rocks, and in this respect, as well as in many of the details, the features of the Texas Archæan are strikingly like those of the Archæan of Manitoba and Minnesota.

Hamlinite; a new mineral. By Messrs. HIDDEN and PENFIELD. (Am. Jr. Sci. 39, p. 511.)

Five years ago the authors observed a new rhombohedral mineral occurring with *herderite* at Stoneham, Me. As the material then noticed was insufficient for chemical investigation the authors deferred publishing any results with the hope that more might be discovered; this hope has not been realized and the present paper is therefore apparently a preliminary one.

come to the conclusion
lium and alumina with fluorine.

A preliminary annotated check-list of the Cretaceous invertebrat Texas. ROBERT T. HILL. (Bulletin No. 4, Geol. Sur. of Austin, 1889.

This valuable publication reveals the great labor that has been bestowed by Prof. Hill, on the Cretaceous of Texas, by has been enabled to more than double the recognized thickne Cretaceous, and to lay down, in a preliminary way, the paleo data by which all its parts may be identified. Not to me early and fragmentary observations of Rœmer, Marcou, the brothers, and the paleontological determinations of Morton, some unproved generalizations were indicated, some of whic in doubt, Prof. Hill has made the first systematic and cont search in the strata of that age in Texas. He demonstrated ence of the great unconformable *Comanche series*, and alth series is claimed as *Neocomian* by Mr. Marcou, and the lowe it as Jurassic, there is no question of its actuality and of that is due to Prof. Hill in elucidating its structure and its Minor details will have to be worked out in the future, an cast their light on the disputed questions all the differen likely to disappear. For the field-geologist in the Texas C indeed for every laboratory worker, this check-list will serve and reference of great value. The list proves evidently th Cretaceous strata in Texas are more recent than the Engl although some have identified Texas fossils with those that belong to the Gault or the Neocomian.

RECENT PUBLICATIONS.

1. *State and Government Reports.*

First annual report of the geological survey of Texas, 1 done in the division of chemistry and physics, mainly during the fiscal year 1886-87. 72 pages with plates. F. W. Clarke.

Bulletin of the U. S. Geological Survey, No. 56. Fossil wood and lignite of the Potomac formation, 96 pages. F. H. Knowlton.

Bulletin of the U. S. Geological Survey, No. 57. A geological reconnaissance in southwestern Kansas. 49 pages. Robert Hay.

2. *Proceedings of Scientific Societies.*

Transactions Kansas Academy of Science, vol. XII, part 1, 1889, contains proceedings of twenty-second annual session ;Notes on the occurrence of gold in Montana, J. R. Mead; On magnetic declination in Kansas, F. O. Marvin; Artesian wells in Kansas, and the causes of their flow, Robert Hay, F. G. S. A.; Some Kansas mineral waters, E. H. S. Bailey; Barite and associated minerals in the concretionary rocks of eastern Kansas, E. H. S. Bailey and E. E. Slosson, (abstract).

The proceedings of the academy of Natural Sciences of Philadelphia, Jan.-March,1890, contain: Pea-like phosphorite from Polk Co.,Florida, Edward Goldsmith; Distribution of color marks in the Pteropodidae, Harrison Allen, M. D.; Fossil vertebrates from Florida, Jos. Leidy, M. D.; Notes on the genesis and horizons of serpentines of southwestern Pennsylvania, Theodore D. Rand; Geology of artesian wells at Atlantic City, N. J., Lewis Woolman.

3. *Papers in Scientific Journals.*

Am. Jour. Sci., July No. Southern extension of the Appomattox formation, W. J. McGee; Notes on the minerals occurring near Port Henry, N. Y., J. F. Kemp; Occurrence of Goniolina in the Comanche series of the Texas Cretaceous, R. T. Hill; Development of the shell in the genus Tornoceras Hyatt, C. E. Beecher; Fayalite in the Obsidian of Lipari, J. P. Iddings and S. L. Penfield; Selenium and Tellurium minerals from Honduras, E. S. Dana and H. L. Wells; Connellite from Cornwall, England, S. L. Penfield.

Am. Naturalist, Nov. No. Character and distribution of the genera of brachiopoda, Chas. W. Rolfe. *April No.* On the brecciated character of the St. Louis limestone, C. H. Gordon. *June No.* The persistence of plant and animal life under changing conditions of environment, Persifor Frazer.

Ottawa Naturalist, May No. On some of the larger unexplored regions of Canada, G. M. Dawson.

Can. Record of Sci., vol. IV, No. 2. Note of a fossil fish and marine worms in the Pleistocene nodules of Green's creek on the Ottawa, J. W. Dawson; Notes on göthite, serpentine, garnet and other Canadian minerals, B. J. Harrington; Scolecite from a Canadian locality, J. T. McDonald; On Asbestus, &c., J. T. Mc Donald; Lower Helderberg formation of St. Helen's island, Wm. Deeks.

4. *Excerpts and individual publications.*

The dynamic influences of evolution,Wm. H. Dall. [Read before the Biological Society of Washington, Mar. 8th, 1890.)

of California. Insular floras. (
state mineralogist of California,)

Description of some new genera and species of Echinoderm
the Coal Measures and sub-Carboniferous rocks of Indiana,
and Iowa; by S. A. Miller and Wm. F. E. Gurley.

The rivers of northern New Jersey, with notes on the clas
of rivers in general, by William Morris Davis, delivered b
"National Geographic Society" at Washington Jan. 24, 1890. I
in the "National Geographic Magazine," Vol. II, No. 2.

The geographic development of northern New Jersey, by
Morris Davis and J. Walter Wood, Jr., (from proceedings Bo
Nat. Hist. Vol. XXIV, 1889).

On some of the larger unexplored regions of Canada, by G.
son, D. S., F. G. S. extracted from the Ottawa Naturalist, Ma

On Cambrian organisms in Acadia, by G. F. Matthew, M.
Roy. Soc. Canada. (Read May 30, 1889.)

The Iroquois Beach, a chapter in the geological history of
tario, by Prof. J.W. Spencer, M. A., Ph. D., F. G. S., Trans.
Canada, (Communicated by Dr. T. Sterry Hunt, May 5, 188

Notes on the geography and geology of the Big Bend of the
by A. P. Colemn, Trans. Roy. Soc. Canada. (Communicate
M. Dawson, May 15, 1889.)

5. *Foreign Publications.*

Die tertiären Bildungen des Kreidberges bei Lünenburg
Stümcke. Jahr. d. nat. wissen. Ver. f. d. Fürstentum I
XI, 1888-1889, S. 91.

Mittheilungen aus d. Min. Inst. Keil, Bd. 1, Heft 2
Bemerkungen über die Gneisse im Granulit des sächsisc
gebirges, E. Danzig; Ueber den Wiesenkalk des Farb
Nindorf Betrachtungen über die Art und Weise, wie die Ge
gel Norddeutschlands zur Ablangerung gelangt sind. H. J. H
ein Neocomgeschiebe aus dem Diluvium Schleswig-Hol
Stolley.

Die Conchylien des Lösses am Bruderholz bei Basel.
[illegible] Nat Gesell. Basel, 8 Theil. 3tes. Heft).

Annual report of the Department of Mines. New South Wales, for 1888. Folio. 233 pp., many maps and plates, Sydney, 1889.

Geological features and mineral resources, Maukai district. Queensland. R. L. Jack.

Geological observations at the heads of the Isaacs, the Suttor and the Bowen rivers, Queensland. R. L. Jacks.

Report on the Sellheim silver mines and surrounding district, Queenland. R. L. Jacks.

Kleine Mitth. aus min. Inst. Univ. Giessen, No. 6, contains: Neue Funde von Mineralien. Gesteinen and Versteinerungen aus der Umgegend von Giessen, A. Streng; Bemerkungen über den Melanophlogit, A. Streng; Eine neue Limatula aus dem oligocän des Mainzer Beckens, G. Greim; Ueber eine eigenthumliche Säulenbildung im Tageban des Braunsteinbergwerks in der Lindner Mark bei Giessen, J. Uhl; Ueber Regentropfenspuren ebendaselbst, J. Uhl.

Zeitschrift der Gesellschaft für Erdkunde zu Berlin, erstes heft, no. 145, "Der Isthmos von Korinth," eine geologisch-geographische Monographie, von Dr. Alfred Philippson.

Annales de la Societe Geologique de Belgique, tome seizième, 1888-1889, contains: Etude sur les dépôts gypseux et gypso-salifériens, M. Ch. De La Vallée Poussin. Etude geologique des Gisements de Phosphate de Chaux du Cambrésis, X. Stanier; Sur les affinités des genres Favosites, Emmonsia, Pleurodictyum et Michelinia à l'occasion de la description d' une forme nouvelle de Favositide du calcaire carbonifere supérieur, Julien Fraipont; Etude sur la stratigraphie souterraine de la partie nord-ouest de la province de Liege, Renier Malherbe; Note sur les roches cristallines recueillies dans les dépôts de transport, situés dans la partie méridionale du limbourg hollandais, Alph. Erens.

Földtani Közlöny, Jan.—Mar. 1890. (Geologische Mittheilungen.) Zeitschrift der Ungarischen geologischen Gesellschaft. Redigirt von Dr. Moriz Staub. Budapest. Enthaltend Daten zur Geologie des Bakony (m 2 Abb.) Dr. F. Schafarzik; Beiträge zur geologischen Beschaffenheit der Umgebung von Munkács (m. 1 Abb.), Dr. J. Szádeczky; Beiträge zur fossilen Flora der Umgebung von Munkács (m. 1 Taf.) M. Staub; Ueber das geologische Profil des Scherunitzer Kaiser—Francisci Erbstollens (m. 1 Taf.); Zur Geologie des Djebel-Bu-Kornein in Tunis (m 2 Abb.), J. Jankó jun.; Kurze Uebersicht der in der Zone des siebenbürgischen Erzgebirges von Zám bis zum Ompolythale erforschten Höhlen, G. Téglás.

Annual report and proceedings of the Belfast Naturalists' Field Club. 1889-90. Series II. Vol. III. Part II. contains the following papers: Report of a committee of investigation on the gravels and associated beds of Curran at Larne, by R. Lloyd Praeger; A contribution to the post-tertiary fauna of Ulster, by R. Lloyd Praeger.

Festschrift zur Feier des fünfundzwanzigjährigen Bestehens des naturwissenschaftlichen Vereins zur Bremen. Abhandlungen herausgegeben vom naturwissenschaftlichen Vereine zu Bremen. Band XI. Heft 1, mit 16 Tafeln. 1889. Heft 2, mit 4 Taf. 1890.

(Smit onian Inst

Notes on the serpentinous rocks of **Essex Co., N. Y. from aq**
shaft 26, N. Y. city, and from near Easton, Penn., Geo. P.
(Smithsonian Inst. Proceedings, Vol. XII, No. 783); Preliminar
on the fishes collected by the steamer Albatross on the Pacific
North America during the year 1889, with descriptions of twel
genera and ninety-two new species, Charles H. Gilbert, (Smith
Inst. Vol. XIII, No. 797.)

Bulletin from the Laboratories of Natural History of the Stat
versity of Iowa, containing: Some new species of palæozoic fos
Calvin; The Loess and its fossils, B. Shimek; A new species o
water mollusk, B. Shimek, and other papers.

CORRESPONDENCE.

Genesis of the Arietidæ, by Alpheus Hyatt. Smithsoni
tributions to Knowledge, No. 673, 4to text, 238 pp., five folio tab
14 Plates; Washington, 1889.—Professor Hyatt begins his pr
saying: "It is a common mistake to designate my classifi
embryological. It will be found by those who read these pa
the whole life of the individual, and all its metamorphoses, h
deemed essential standards for the estimation of affinities.
degradational metamorphoses of old age are used as chara
of value in the generic descriptions; it is properly speaking
logical classification." (*Loc. cit.* p. VII.)

The mistake is due to the long and careful studies of profes
on the embryology of Cephalopodes in general and of the A
in particular, and by the late professor Louis Agassiz sa
Hyatt was working out the embryology of the Ammonites.
a misuse of a term too long employed for all the work of cla
at the Museum of Comparative Zoology, and which has bee
to designate briefly the starting point of the true ontological a
al classification so well advocated by professor Hyatt.

homme de génie, stoique et désinteresse" as he is called by Geoffroy Saint-Hilaire, presented his doctrine of progression, which was so much in advance of the standard of his time, that it took more than half a century for it to be truly appreciated at its real value; it was not until after the publication of the "Origin of Species" by Charles Darwin, in September, 1859, that the grand generalizations of the French naturalist began to be thought of by the new generation of naturalists; and now it is a true triumph for his long neglected doctrine of variation, to see a school, with such representatives as professor E. D. Cope, Dr. A. S. Packard and professor A. Hyatt, appropriately called "the Neo-Lamarckian."

The author of the "Philosophie Zoologique,"of the "Flore francaise," of the "Histoire naturelle des Animaux sans vertébres" and of the "Coquilles fossiles des environs de Paris," Jean, Pierre, Baptiste, Antoine de Monet de Lamarck, after being neglected for so many years, and having his reputation shadowed and almost totally obscured by George Cuvier and his school, comes out again, thanks to the careful researches of a new school, which strange to say has been educated and trained by one of Cuvier's most illustrious pupils, Louis Agassiz. It is a new example which shows how useless are all the opposition and neglect of contemporaries and adversaries, to views based on facts rightly observed and interpreted. And it is a great spectacle to witness now the rehabilitation of a naturalist,who, if he had done nothing else but his splendid work "Les Animaux sans vertébres" has left a reputation second to no one; but whose far seeing and far reaching philosophy of gradual and insensible evolution of species, places him in his right place as a naturalist of genius among the foremost great thinkers as well as great observers.

The first part of professor Hyatt's memoir, will attract the attention of all zoologists and will have undoubtedly a strong influence on young American observers, as a rare example of close reasoning, based on a great many facts well studied and carefully recorded. To be sure it is the part most open to criticism, on account of its theoretical leaning; but it is written with such candor, and the conclusions are so fairly drawn, that it will remain as a precious acquisition to our biological knowledge of a family of highly organized invertebrates.

The second part, "Geological and faunal relations,"is addressed to geologists well trained by long practical researches in the field of the lower and middle Lias. Although professor Hyatt says that "his researches where conducted almost wholly inMuseums,"he made himself well acquainted,not only with all the stratigraphy and practical work in the field of local geologists, but he studied carefully the beds of the Jurassic and Triassic systems in several of the classical areas of southern Germany and eastern France; and it is to his practical knowledge that is due the great value of his "Remarks on faunal relations." I would call attention especially to what follows: "That the North American assemblage of species has a distinct facies of its own, and ought to be separated at least provisionally from the South American

[illegible]

Professor Hyatt instead of using the terms Mediterranean,
Europe and Russia for the homozoic band of the Jurassic per
by the late Melchior Neumayr, the celebrated and much regret
fessor of palæontology of the University of Vienna, in hi
"Ueber climatische zonen der Jura, etc.," has adopted the nc
ture of tropical, temperate and polar homozoic bands. C
Neumayr's names are not well appropriated to the homozoic
the Jurassic period in America; only the terms of tropical and
ate are objectionable, because the tropical of the Jurassi
encroaches on the actual temperate to such an extent as to an
almost entirely the term temperate as it is understood in our
time; and it is more appropriate to use the terms *central* in
tropical, and *neutral* instead of *temperate*, on account of the va
in the limits of those two bands in the Jurassic time when c
with the present physical conditions of the world.

Hyatt thinks that some of the basins in the Lower Lias per
capable of evolving new forms; and he named them "*Aldainic*
because they were centers of origin of new series, and their fa
called "autochthonous." He had arrived at the important "
the beginning of the Arietidæ was in the northeastern Alps; the
Germany was peopled by chorological migration, and then t
of the Jura and Côte-d'Or. Thus a zone of autochthones, or
nic band of basins, were formed running to the westward. N
south of this zone all faunas seem to have been residual fauna
cit., p. 89.)

After reviewing all the observations regarding the proba
and migration of his sub-genus Psiloceras, Tmægoceras, Wæhi
Schlotheimia, Vermiceras, Caloceras, Arnioceras, Coronice
siseras, Asteroceras and Oxynoticeras, professor Hyatt has
condensed all his facts in most interesting tables of the ge
the Arietidæ. Table I, for the fauna of south Germany; tabl
fauna of the Côte-d'Or; table III, fauna of the Rhone basin
fauna of England; table V, fauna of the province of centra
and table VI, fauna of the province of the Mediterranean. .

Those genealogic tables are the result of an immense amou
[illegible] classified

during the last twenty years. The tendency to use such expressions, which after all is nothing else, on the part of those who employ them, than an admission of their inability to arrive at the exact geological and chronological age of a certain amount of strata, is mischievous in the extreme, because it introduces into a science, which cannot exist without the most perfect chronology, a sense of uncertainty contrary to the good and proper understanding of all that relates to succession, development, evolution and geological age.

The following paragraph is most interesting on account of its precision and its well balanced classification: "The ammonoids, therefore, according to our views, are not divisible into two grand divisions, but have six suborders: the Goniatitinæ, of the Silurian, Devonian, Carboniferous, Dyas, and Trias; the Clymeninæ of the Devonian; the Arcestinæ of the Dyas and Trias; the Ceratitinæ of the Dyas and Trias; the Lytoceratinæ of the Trias, Jura and Cretaceous; and the Ammonitinæ of the Trias, Jura, and Cretaceous." (*Loc. cit.* p. 7.) According to Hyatt's view, two of the suborders of the ammonoids are special and characteristic of the Dyas and Trias, a result completely in harmony with professor Huxley's opinion of the Vertebrata. It is most important to see such paleontological observers as Huxley and Hyatt agree in placing the separation between the palæozoic and the Mesozoic below the Dyas, as it has always been advocated and maintained by all practical geologists.

The divisions used by professor Hyatt for the Lower Lias,are excellent and very complete, beginning with the Bone-bed of Quenstedt, and extending from the Planorbis beds to the Raricostatus belt. He has carefully avoided placing the Rhetic in the Lias, leaving it in the Trias, which is its proper place according to stratigraphy, lithology and a well balanced palæontology. In fact all the geological classifications used by professor Hyatt, show precision and discrimination seldom equalled in a paleontological work and which recall most happily the great geological wisdom of Barrande.

The third or last part of professor Hyatt's memoir is the most extensive, covering almost half of the volume, from page 120 to p. 221; it is devoted entirely to practical palæontology, giving the "Descriptions of genera and species of Arietidæ." He begins with the "Radical stock" first, or Psiloceran branch with the genera Psiloceras and Tmægoceras, then come the second branch with its Wæhneroceras and Schlotheimia, then the third branch with its Caloceras and Vermiceras, then the fourth branch with its Arnicoceras and Coroniceras, then the fifth branch with its Agassiceras and Asteroceras, and finally the sixth branch or Oxynoteras.

All the species described and figured are European with the exception of *Caloceras newberryi* Hyatt, from near Cerro de Pasco, Peru; *Caloceras ortoni* Hyatt, from Tingo, near Chacapoyas, northern Peru; *Arnioceras? nevadanum* Hyatt. from near Volcano, Nevada; and *Arnioceras humboldti* Hyatt, from Humboldt county, Nevada, which show beyond any possible doubt the existence of the Lower Lias in West

the genus Ammonites of Bruguière, [illegible]
nites, Orbulites and Planulites. Sowerby in his "Mineral co
of Great Britain," 10 vols. 1818-1829, divides the Ammonites i
sections, according to the forms of the back. Von Buch
great sagacity saw that the lobes of the chambers of the sl
regular according to species; and combining the forms of the l
the exterior ornaments of the shell, he was led to divide th
nites of Lamarck into nine great series called by him Arietes,
etc., etc. He began his paper of 1829: "Sur la distribution d
nites en familles (*Ann. Sc. Nat.*, vol. XVIII, p. 417, Paris),
that "probably all the Ammonites can easily be classified in
families, and that he found such an arrangement at the Muse
University of Basel (Bale), Switzerland, under the direction
Mérian." During the years 1825-27, von Buch worked at h
cation, believing that he was the only paleontologist interes
question; when to his great surprise, during a visit at the M
Bale, he saw all the Ammonites classified by professor Méri
ly in the same order that he had arrived at in his own collecti
lin. At first he thought he had been betrayed by somebody,
minutes of conversation with Mérian dissipated all his suspi
Mérian with a rare modesty and disinterestedness, not o
claim any right of priority or even of equality in the discove
relinquished all thought of even saying anything about it;
Buch had not stated the fact in his paper of 1829, it would ha
ed unknown. From that day von Buch and Mérian be
intimate friends and every year von Buch used to visit Méri
least, often twice and even three times.

The Arietes or "Les Béliers" in French, are so well define
lines consecrated to their diagnostic by von Buch, at p. 418
that nothing has been changed in that family ever sinc
paleontologists from d'Orbigny, Quenstedt, Pictet, Oppel t
Mojsisovics and Hyatt; and even his first saying that all th
that family belonged to the Lias, has been confirmed b
Hyatt, whose exhaustive monograph of Arietidæ shows thei
in the Lower Lias, with only two species of Oxynoticeras p
[illegible] Von Buch quotes only eight species of

The paper is not only an honor to its author, but even more it is most creditable to American paleontology that such an important memoir has been worked out and published in America, on material mainly collected and derived from Europe. It is a rare and most valuable contribution to the paleontology of the first great group or base of the Jurassic system. Only it is so profound and it requires such an amount of special knowledge to understand all the meaning, reasoning and conclusions of the author that it is doubtful if a single person in America, besides professor Hyatt, is able to read critically every part of the "Genesis of the Arietidæ." Certainly the biological part is accessible to all zoologists and will be much appreciated, more especially by the young generation of American observers; but the geological part can be understood only by those who have studied with detail the Mesozoic faunas and the stratigraphy of Dyas, Trias and Jura in central Europe, and the number of such American geologists can easily be counted on the fingers of a man's hand.

In Europe the work of professor Hyatt will exercise the most beneficial influence, and we know already it is highly estimated by all the Austrian, Belgian, English, French, German, Italian and Swiss observers, who have devoted themselves to researches of the same sort, and although their number is necessarily limited, it is sufficient to reward professor Hyatt for his great effort in his work of progress, for his last publication has placed him in the front rank of paleontologists. J. M.

Cambridge, Mass., 15 May, 1890.

ON THE NAME "LAURENTIAN."—In the April number of the GEOLOGIST, (pp. 197-200) Prof. C. H. Hitchcock refers to a paper of mine in the January number, upon the use of *Laurentian* as applied to a Quaternary terrane. On page 197 he says: "It is to be regretted that Mr. James did not examine my reference to the publication where Mr. Desor proposed the use of the name Lawrentian." Unfortunately Prof. Hitchcock does not refer to any paper of Desor's where the word "Lawrentian" was used, either in his report on the Quaternary (AMERICAN GEOLOGIST, vol. 2, p. 303), or in the Report on the Geology of Vermont (vol. 1, p. 157.) I am glad to know, however, from the foot note reference in his article where and when the name was first used. As far as the origin of the name is concerned, there can be no question but that Desor derived it from the St. Lawrence valley, where the deposits were first studied.

On page 200 Prof. Hitchcock says, that "Mr. Desor disclaims the origination of the application of the term Lawrencian." [Lawrentian.] It should be remembered, however, that the report in the Proceedings of the Boston Society of Natural History was not written by Desor himself, but by a third person. We are, therefore, hardly justified in accepting either the language or the spelling of the term as that of Desor. But, however this may be, in other places Desor *did* claim to be the author of the term, and in these papers it was not spelled Law-it could be applied to a

be used for the crystalli rocks as designated by Logan. the term "Champlain" can hardly be used. It was clear ed by Emmons.

I take this opportunity of correcting two errors in the my paper: page 30, note 2 read *1851* for 1859; page 31, not *9* for vol. 19.

JOSEPH

Washington, D. C., July 1, 1890.

PERSONAL AND SCIENTIFIC NEW

PROF. C. H. HITCHCOCK IS ON A VISIT TO MT. WHIT party of excursionists. In July he visited the islands, Caribbean sea.

PRINCETON SCIENTIFIC EXPEDITION. A Princet tological party composed of Profs. W. B. Scott, W Mr. John Eyerman and six Princeton undergraduat Princeton the latter part of July for a trip throug river country of Nebraska and Dakota. Mr. Eyer pects to explore in south-western Colorado.

THE ROCKY MOUNTAIN CLUB, which was organi year ago at the University of Michigan, has been as to include other northwestern institutions, and ship now numbers about ninety. Its purpose is examine, with such care as the objects of the club points of scientific and popular interest in the F tains. Its second annual excursion, under the gu A. Winchell, occupied two weeks in the latter leaving St. Paul on July 14.

THE MENAGE SCIENTIFIC EXPEDITION TO THE F LANDS, started from Minneapolis July 22nd and w two years on the Islands making collections for t Academy of Natural Sciences. This expeditio

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A SKETCH OF RICHARD OWEN.

By N. H. WINCHELL, Minneapolis.

Richard Owen, whose sudden death occurred at New Harmony, Indiana, March 24th, 1890, by accidental poisoning[1] was the youngest brother of David Dale and Robert Dale Owen, and was associated with them in many of their undertakings. He participated in some of the early geological surveys, particularly in that of Wisconsin, Iowa and Minnesota, and that of Indiana. He had long been known extensively as an author, teacher, scientist and soldier. He was born Jan. 6, 1810, at Braxfield House, Lanarkshire, Scotland, and was therefore at his death somewhat more than eighty years of age.

Dr. Owen received a training similar to that of his brother D. D. Owen, namely: tuition under a private tutor, later at the Lanark grammar school, subsequently three years (after 1824) at Hofwyl, Switzerland, where, with military drill and daily gymnastics, he acquired familiarity with French and German, and made chemistry a specialty, then again in Glasgow a full course in chemistry and physics with Dr. Andrew Ure at the Andersonian Institution. With his brother, D. D. Owen, he

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[1] The death of Prof. Owen was peculiarly distressing. A jug of embalming fluid was sent by mistake to a neighbor of Prof. Owen (a merchant), labeled "medicated water." Thinking it mineral water from some friend the two drank a small quantity, and its deadly quality was soon discovered. Medical aid was summoned, but Prof. Owen succumbed under its effects, and died before midnight.

was engaged,
stances having placed a considerable amount of lan
grain, also a merchant steam flouring-mill in
he conducted the same for seven years, and in thi
his former experience in farming in Lancaster cou
and a three years service with his friend Dr. Wm
Cincinnati, chiefly learning malting and brewing,
plied him a valued and adequate preparation.

Through the aid of his brother, Hon. R. D. Owe
Congress, he was appointed captain in the 16th U.
and remained seventeen months in Mexico, from
to August 1848, chiefly near Monterey, with Gen.
charge of the provision trains.

On returning from the Mexican war, Dr. R. Owen
brother Dr. D. D. Owen engaged in a survey of
Territory, and devoted the autumn and winter of
special preparatory training for the duties assig
1849; which duty took him to the north shore of
ior and as high as Lake of the Woods, and consiste
making the barometrical observations, and the
sketches, diagrams, &c, especially showing the
trap upheavals, sometimes in basaltic arches of g
A majority of the woodcuts in the body of the qua
Dr. D. D. Owen (sub-report by Dr. Norwood) are f
cil of Dr. R. Owen.

Late in 1849, Col. Thornton Johnson (cousin of
Johnson, vice president of the U. S.) who had
Drennen Springs in Kentucky the "Western Milita
on the plan of the U. S. Military Academy, offere
the chair of Natural Science in that institution. T
ed and remained over nine years connected with

Col. Bushrod R. Johnson, The address was delivered at the request of the ladies of the Mount Vernon Association, in the capitol at Nashville and was printed in pamplet form under the title "Honor to the Illustrious Dead." While at Nashville he received (in 1858) his degree of M. D. from the Nashville Medical College after a two years' course.

On reaching his home at New Harmony, Ind., he was immediately employed in the Indiana Geological Survey, and on the death of his brother, Dr. D. D. Owen in 1860, was appointed state geologist. He was still engaged on his 8vo. report of that reconnaissance, when he was offered by governor O. P. Morton the Lt. Coloneley of the 15th Inda. vols. and accepted; reading the proof of his report, in camp, May, 1861.[1] After the battle of Greenbrier, W. Virg., Dr. Owen was promoted colonel of the 60th Ind. Vols., which he had enlisted, and remained with his regiment until Dec. 1863, participating in the capture of Vicksburg and Jackson, Miss. and in the Red River campaign. He was with Gen. Reynolds at the battle of Rich mountain and participated in the defense of the camp at Huttonsville. In the same regiment were Dr. Owen's two sons, as subordinate officers. The winter of 1861-62 he guarded at Indianapolis 4,000 prisoners captured at Fort Donnelson. In the spring of the following year he was ordered to Kentucky, and his regiment was taken as prisoners of war by Gen. Bragg at Mumfordsville. Three months later they were exchanged. Although the regiment was paroled, Dr. Owen was not, nor were his side arms taken. On the contrary Gen. Buckner went out into the field where the regiment was guarded and thanked Col. Owen for his kindness to the 4,000 Fort Donnelson prisoners at camp Morton. Gen. B. R. Johnson, with whom he had been associated as teacher, and two students, then officers in the confederate army, whom Dr. Owen had often drilled, also called on him. He was treated very politely by Gen. Bragg with whom he had become acquainted in the Mexican war.

After the exchange he was ordered to the southwest and participated in the capture of Arkansas Post. His regiment lost quite extensively in killed and wounded in this engagement. He was with Sherman in the first attempt on Vicksburg, and afterwards at the capture of the city by Grant, July 4, 1863.

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[1] See p. 280 of his report: "Geological Reconnaissance of Indiana, 1860.

been ordered to bring up and protect the rear.

Jan. 1st, 1864, fresh from Red river campaign,
stood for the first time on the rostrum of the Indian
sity, Bloomington, where he labored for 15 years, en
to infuse into his classes a love for natural science, p
ly geology, biology and chemistry. During his c
with the Indiana University he made geological
sances, in 1864, in New Mexico and Arizona, als
North Carolina, and in 1869 he visited Europe, and
Asia and Africa.[2]

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[2] He was in Paris 15th Aug. during the centenary birthday
of Napoleon the First; in Athens during the visit of empress
Jerusalem meeting the emperor of Austria and crown prin
sia, all on their way to the opening of the Suez canal, 17 No
reached Port Said 16 Nov. and saw the pageant of reception
royal representatives of the different nationalities.

The route taken, to reach all these places, was from Vien
iting Adelsberg grotto and obtaining a living Proteus (subse
served in alcohol, and now in the museum at Purdue
down the Danube, thence over the Black sea to the Crimea
geological specimens from Sebastopol, Balaklava, Simphe
and back to Constantinople (picking up basalt on Bospho
Scutari) then to Athens where he saw fine specimens of the
Hipparion and Rhinoceros from the Tertiary a short dista
that city over to Smyrna with its tomb of Polycarp dating
turies; the Island of Rhodes, still exhibiting the gra
tions erected by the Knights Templar; Syria replete with
bible history; thence to Egypt. He describes the pyrami
as being entirely of Nummulitic limestone, of which h
specimen, now in Purdue Univ'y, while the pyramid nex
a syenitic rock for its entire base, and the Sphinx is scul
sandstone *in situ*, of Cenozoic age.

Returning by way of Sicily, he ascended Mount Etna
lavas of different periods; in and around Naples he exan
teresting geological records, such as mount Monte Nuov
of Jupiter Serapis, the Solfatara (bringing home from
vents specimens of arsenic sulphide, etc.) thence Vesuv
and Herculaneum; thence through Rome and Florence,
Bonn, in the region of the Siebengebirge and

In 1874, Wabash College conferred on Dr. Owen the degree of L.L.D. and in the same year he was elected Grand Master of Indiana I. O. O. F. and subsequently Grand Representative of that order to the Sovereign Lodge of U. S. He was also an honorary member of the New Orleans Academy of Science, also of that of N. Albany Ind., and later charter member of the Ind. Acad. of Science. Being a Fellow of A. A. A. S., when the Geological Society was formed, he was enrolled as a charter member. He was elected (1872) president of Purdue University at La Fayette, Ind. but in consequence of the delay in organization he resigned in order to accept at the Ind'a Univ'y., in addition to retaining his original chair, the curatorship of the Museum. The Trustees had bought the large collection of Dr. D. D. Owen, known as the "Owen Cabinet" and made many valuable additions, besides the necessary cases through purchases from the interesting establishment of Prof. Ward of Rochester, N. Y., giving Dr. R. Owen, genial occupation in arranging, labeling, etc. Unfortunately the museum was destroyed July 12, 1883 by fire some years after Dr. O. left Bloomington, only a few of the type specimens, which were in seperate portable cases, being saved. These have subsequently formed a part of the collection in the new museum.

Dr. Owen remained at Bloomington from 1864 to the end of the session of 1879, having resigned in 1878 in consequence of impaired hearing caused by sunstroke. From that time he lived quietly at New Harmony Indiana, and on Jan. 6, 1890, celebrated his eightieth birthday.

Dr. Owen married in 1837, Miss Anne Neef, youngest daughter of Prof. Joseph Neef, formerly coadjutor with Pestalozzi, and author of two educational works. Three children were

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the Lias, as several quarries exist in the neighborhood for obtaining, in that formation, a hydraulic limestone. Dr. O. states that after they have carted and dumped along the margin, say of a ten acre field, all the soil, and have quarried and removed all the available hydraulic limestone, they then return the debris and finally the soil. He saw good crops growing on fields thus treated.

While traveling in Palestine, Dr. Owen obtained at the Sea of Galilee, trachyte, amygdaloids and other volcanic rocks; also there and at the Dead sea the evidences of earthquake action were very striking. He published in "The Holy Land" (a quarterly journal,) some of these facts, and the reasons for believing that although by these catastrophes the surface of the Dead sea is now over 1,200 feet below the Mediterranean, there is evidence to show the probability that, before these convulsions, the Jordan emptied its waters through a valley still traceable from the Dead sea, past Petra to the gulf of Akaba in the Red sea.

study of natural history, which he loved so well, name of Owen Hall, in his honor. "The older stud University remember him with great respect. One his eminent success as a teacher was his knack of young men. His idea was that young men of 'c should be taught self-government, and that part of tl ment of discipline might be left to their own manag der a code formed by themselves and approved by th Dr. Owen was a member and deacon of the Pr church.

Throughout Dr. Owen's works he evinces the spiri cere lover of and seeker after truth. His address students of the University, his communications to t ical literature of his time, no less than his unostent dustry and his simple and consistent christian lif the devout spirit with which he carried on all his

Although the literary work of Richard Owen was multifarious, yet he did not seek the more exclusiv channels of publication. He desired to reach a wide and produce an immediate impression. His pape found in educational journals, in some of the New bany weeklies, in stray pamphlets and in some of scientific serials of the United States. One who w at the Kentucky Millitary Institute gives a glimps dustrious life he spent there in the following words

> "I studied geology, natural history and chemistry un also taught German and Spanish, and instructed in fenci ionally in dancing, and did part of the drilling in militar was always busy,—going to his room one would find hi painting and drawing, and he was very good at that."

It is due to a life of so many years of labor, tha ld here in a more detailed category, of

1846. Descriptions and drawings, from microscopic observations of the FlyingWeevil,a troublesome wheat pest in Indiana, *Albany Cultivator*, July and November (see also Jæger's *Life of North American insects.* p. 185).

1849. In his brother's quarto report on Wisconsin, Iowa and Minnesota a chapter, with a map, by R. Owen is descriptive of Pigeon point, Minnesota.

1857. Key to the Geology of the Globe, with numerous original maps and diagrams, A. S. Barnes & Co., New York. 256 pp. 8vo.

1862. Report of a geological Reconnaissance of Indiana (David Dale Owen, State Geologist,) By Richard Owen, principal assistant, now state geologist, pp. 368. Roy. octavo.

1864. The rock salt at New Iberia, Louisiana. *Transactions of the St. Louis Academy of Science*, vol. II, p. 250, Sep. 1864. (copied in *Am. Jour. Sci.* vol. XL, (II), p. 120.

Various articles in the *New York Tribune*, *Indianapolis Journal* and *Indiana Farmer* calculated to popularize science.

1864. Dr. Owen this year made a geological survey in *New Mexico and Arizona*, his report being printed in octavo pamphlet. (*Report on the mines of New Mexico*, by Profs. Owen and E T. Cox, Washington, 1865, 60 pp. 8vo.) A similar survey and report were subsequently made in North Carolina.

"A western glance at eastern scenes." A series of 15 letters in the *Evansville Journal* [Ind.] giving details of his foreign travel. Other letters were published in the *New York Tribune*

After leaving Bloomington Dr. Owen prosecuted his researches in physical geography and seismism. His papers are found at various dates in the reports of the *American Association for the Advancement of Science*, *in the Scientific American*. and the *American Meteorological Journal*. He also published a series of papers in the *Southwestern Journal of Education*, (Nashville), detailing some observations not found in works on physical geography. To these he gave the title: "Aids to the study of Geography."

He competed for the prize of 25,000 francs offered by the king of the Belgians for "The best system of popularizing geography." Of sixty competitors Dr. Owen was one of four to receive honorable mention, the prize being awarded to a German professor. Among the recommendations made in Dr Owen's essay was the employment of relief maps, since he

He also sent eighty-five original maps [illegible]
relief map of Europe, in four pieces, was colored
from the map of Sir R. I. Murchison, and was
size, viz: about 50 by 42 inches. After the award
els, maps and diagrams, etc., were presented,
American minister at Brussels, judge Lambert
"scholastic museum," in which, according to
Journal" of 15 Nov., 1887, they occupy a spec
Due acknowledgement was made by the Belgian
education.

Dr. Owen also communicated a paper to the Bo
of the *International Congress of Geologists*, for whi
ed the cordial thanks of the president, Sig. Capel

Notices of Dr. Owen's works may be found in I
Dictionary of authors," also in "Appleton's C
American biography;" but a brief summary of
and conclusions on dynamical geology may n
place here. For details on these, and simila
reader may consult the *Proceedings of the Americ*
for the Advancement of Science, at the Indianap
Boston, Cincinnati, Montreal, Philadelphia ar
meetings; also the *Polytechnic Review*, New York
cember, 1878; *Journal of the Franklin Institute,*
Scientific American, March 29, 1884, and March
western Journal of Education, (Nashville), five nu
February and December, 1888, and the *America*
Journal, (Ann Arbor), Sept., Oct., and Nov., 1
and Nov., 1887; Nov. 1888 and Jan. and April 1
the latest of Dr. Owen's scientific publicat
prompted by an inquiry of the writer on the ma
[illegible] " tube at Gordonsville, Minnesota,

its crust, consequently they deal with earlier refrigeration, as well as later seismism.

1. The fundamental idea, partly set forth in the "Key," and more elaborated in later publications, was that the present configuration of land and water was to a considerable extent prefigured and determined during the earlier crust consolidation. Thus we may trace two vertical great circles, at right angles to each other; one passing, in the eastern hemisphere, through the Caspian sea, and, in the western, along the Cascade range, the other through Greenland and Japan. They divide our globe into four equal segments,each embracing a double continent: (a)Europe Africa, (b) N. and S. America, (c.) Asia and Australasia (d.) N. and S. Oceanica. Great continental trends form, with this meridional segmentation, angles of about 24°. This primal arrangement does not conflict with subsequent important changes in the position and form of continents, *within* those bounds.

The above described segmentation, as well as the continental outlining, seems connected with the two great movements of the earth: one, that of daily axial rotation, chiefly influencing or promoting symmetrical vertical, meridional, segmentation (elevation and depression); the other determining the coast trends and outlines, which in their angular divergence of 23°-24°, from the meridian, indicate a connection with the annual revolution of the earth in its orbit, inasmuch as they are perpendicular to the plane of the ecliptic, and hence remotely connected with solar influence; as well as being probably affected (in the early history of the planet, when partially fluid interiorly) by lunar tides.

2. Dr. Owen showed later that the eastern trends of the five continents (Asia, Africa, S.America, N.America and Oceanica) are 72° (=3×24°) apart, if we include as a continent, sinking or rising Oceanica, and that a radius of $\frac{72}{2}$° (=36°) nearly defines the continental bounds, and passes usually through Cenozoic areas.

3. He called attention to the greater prevalence and enlarged areas of later geological formations, as we trace southerly divergence from the more restricted, northerly Archean.

4. He claims to have demonstrated that the European Alps near Monte Rosa, constituted the pole of the land hemisphere, being intermediate between the equator and its pole, between

and the same meridian is p
netic system by which the magnetic needle for mid
-Africa, diverges equidistantly west to Boothia F
about 333 years, east to northern Siberia.

5. This seismism has been, and still is, most re
mitted along the strike of rocky elevations, notabl
ranges such as the Andes and Alps, usually in grea

6. Dr. Owen suggested that the elevation of lan
molecular activity in some form, and conse
motion, energy which remotely is derived (in *our* s
from the sun; the motive cosmical origin, not only
but of the stellar universe, being the result of the p
tic, creative impulse.

"The chief *new* scientific fact which was brought
work, judging from its being copied into Dana'
and Cope's works and the latest French geological
Lapparent, is that the general coast trend of con
their chief mountain ranges form angles of 23½ d
the meridians, the latter according with the *axis of*
trends whether east or west, being secondary to t
the ecliptic, according, therefore, with the *axis of o*
tion."[2]

Dr. Owen's lines of research were marked by ori
his conclusions, though often striking, if not bol
modestly before the public. He was one of the t
thorities on earthquakes, and on the location of th
their disturbances, and their movements in given l

His life, which in its voluminous correspondon
co-laborers articulated at one end with the labors o
Murchison, Mather and Emmons, spans an interva
been fraught with activity and progress in all the

and training were of the old regime, and he ever manifested the scrupulousness of statement, of personal manner and of conservative caution which its influence engenders He was not a great leader, but he filled well and long various subordinate posts of duty and responsibility which fell to his charge.

THE CARBONIFEROUS AREA OF CENTRAL TEXAS.[1]

RALPH S. TARR, Austin.

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I. *General Statement.*

1. POSITION OF THE FORMATION.

The Cretaceous beds in central Texas have been removed from a portion of the valley of the Colorado and Brazos rivers so as to reveal the underlying Palæozoic rocks. This region which has been called by Prof. R. T. Hill[2] the Central Deunded Area, consists in its southern portion of a very much disturbed region of older Silurian and Cambrian rocks with granite bosses and possibly Archæan Schists. Unconformably upon this is a belt of lower Carboniferous partially revealed by the erosion of the overlying unconformable upper Carboniferous. Above the latter there is Permian.

2 EROSION OF THE CRETACEOUS.

Whether the Cretaceous covered all this central area is a mooted question. There seems to be no evidence to the contrary and Prof. Hill has announced[3] the probability of such former extension. In several places the Cretaceous is found resting on

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[1] Published by permission of E. T. Dumble, State Geologist for Texas.

[2] AMERICAN GEOLOGIST, Jan. 1890.

[3] Am. J. Sci., Apr., 1889, p. 284.

deep water
once covered all this region, particularly since th
surrounded by a receeding Cretaceous bluff. Th
ferous has been uncovered from beneath a unifo
Cretaceous strata is evident at first sight. Not
sounded by a receding bluff of Cretaceous b
Cretaceous strata extend over, and isolated bu
much degraded patches remain upon the Carbo
so-called Santa Anna mountains of Coleman
of two isolated buttes of Cretaceous rock, in th
Carboniferous, separated from the main mass of
on either side by more than fifteen miles.

3. BOUNDARIES OF THE CARBONIFER

a. Probable Extent.

On the east and west of this Carboniferous a
ceous beds form an almost uninterrupted bou
which the continuation of the Carboniferous
This boundary is broken west of the central p
the Permian occurs. Northward the Carboni
away towards the Indian Territory, and
undoubtedly continuous with the Carbonifero
tion. On the south is the old pre-Carbonife
present there is revealed an insular patch of
small size; but the evidence of the Carbonifer
to point to a former much greater extension
area (as I shall show below) east of the Carbo
neath the Cretaceous.

b. The Silurian Area.

The Silurian as at present revealed in Plano,
ties is a very much deg

rocks of the Carboniferous system the Silurian is chiefly marble, with much contained flint of concretionary origin. The fossils are chiefly destroyed by metamorphism, but it is easy to separate the two systems on lithologic grounds. An irregular line of contact between the Carboniferous and Silurian shows an extensively eroded pre-Carboniferous land, and the ancient shore line, with its bays, promontories and islands, presents an interesting field for study.

c. *Lower Carboniferous Series.*

Resting unconformably on the Silurian rocks is a narrow belt of lower Carboniferous limestone somewhat disturbed by small synclinals and anticlinals, but with a general dip of one or two degrees to the northwest, and a thickness of several thousand feet. The breadth of the strip between the Silurian and the receding edge of the overlapping upper Carboniferous varies from a few hundred yards to several miles, the linear extension of the strip being diagonal to the dip. The evidence of unconformity is given elsewhere.[4]

II. DESCRIPTION OF THE UPPER CARBONIFEROUS SERIES.

1. *Thickness of the Series.*

Above the lower Carboniferous in the valley of the Colorado river and its tributaries is a series of beds having an aggregate thickness of more than 8,000 feet in the area uncovered by the erosion of the Cretaceous. I have recently finished a detailed study of a portion of these beds, principally in Coleman, McCulloch and San Saba counties, and have made a cross section of the series from the Cretaceous on the southeast in Lampasas county to the northwestern Cretaceous in Coleman county. The entire length of the cross section is not far from seventy-five miles. North of the area is a partially continuous ridge of Cretaceous outcrop, forming the divide between the tributaries of the Colorado on the south and the Brazos on the north. Beyond this ridge the Carboniferous strikes northeast toward Indian Territory. In this area the upper Carboniferous beds, which in the southern region are buried beneath the Cretaceous, are revealed. When these are studied several thousand feet of strata will be added to the Carboniferous series.

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[4] 1st Annual Report Texas Geol. Survey for 1889.

slightly disturbed by
detected nor any large folds. At isolated places sou
where the Cretaceous has been eroded from the Palœo
a southeast dip has been reported. This has bee
evidence of a broad anticlinal, but the evidence is i
It is possible that the dip thus reported is connecte
of the disturbances which have occurred in this regi
Carboniferous times. Such is plainly the case in t
described by Prof. Hill, near Marble Falls.[5] So f
observations have gone there is no evidence of an
fold. The beds may be traced from the lower to
in monoclinal sequence. I believe the beds were de
the north and west of a former much more extensive
perhaps continuous with the older rocks of Indian
and that the post Carboniferous disturbances in t
have been very slight, consisting of a general eleva
tilting to the west. Contrary to the general hypot
anticlinal I am inclined to believe that we have in
a great synclinal trough whose western extension wi
in the Rocky Mountain uplift. My reason for t
most of the beds of the upper Carboniferous in t
are of littoral origin, and even well up in the secti
able above the middle, are conglomerate beds w
chiefly flint derived from rocks closely rese
Silurian of the southern region. That some sourc
that now visible must have been drawn upon for th
part, seems evident from the fact that such congl
cur thirty miles north of any visible source. T
to suspect that a Silurian land area is buried
Cretaceous east of this. The lower beds, or tho
eastern area of Silurian, are coarse-gr

water beds derived from this shore, that the hypothesis of an extensive anticlinal is untenable. What connection this Carboniferous series bears to that of the mountains in West Texas I hope to ascertain this summer. At the present time our scanty evidence on the subject seems to indicate a central basin changed in Permian times, after a slight uplift, to an inland sea, and then, after a long period of denudation, followed by the cycles of Cretaceous deposition, and finally the grand uplift of the Rocky mountains with all its involved complication of contemporaneous disturbance and subsequent erosion.

3. DIP OF THE BEDS.

In estimating the dip of these beds considerable difficulty is encountered in determining a mean average. The dip is so gentle that the slightest disturbance by recent down-dropping or contemporaneous irregularity frequently not only lessens the dip, but even at times reverses it. In the few previous observations on this central Carboniferous area the dip has been placed at a very low figure—even as low as thirty feet to the mile. Numerous observations and a carefully drawn average have convinced me that this is much too low, and that one hundred feet to the mile is not an over estimate, but if anything something under the true dip. In my calculation I have used one hundred feet per mile as the estimated dip.

4. DIVISION OF THE SERIES.

a. Richland Sandstone.[6]

The lowest observed beds of the upper Carboniferous are sandstone with some interbedded shale and conglomerate, the whole obtaining a thickness of 4,500 feet. Without any better evidence than its uniform sandy nature and its position as the lowest division of the upper Carboniferous unconformably resting on the lower Carboniferous, this may be called the Texas equivalent of the millstone grit and the upper 3,500 feet the coal bearing beds. The sandstone of this division is

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[6] The use of the word Richland needs some explanation at this place. I proposed the name San Saba sandstone, but this name was needed by another member of the Texas survey. The name San Saba used in my manuscript was accordingly changed to Richland. The new name was unfortunately chosen since the sandstone is not well developed at that point. It occupies nearly one-third of San Saba county. Owing to absence in the field I could not be consulted on the subject. The First Annual Report Texas Geological Survey, contains an announcement of this and the other division used in this paper.

chiefly plant impressio [illegible]
sigillaroid types and imperfect casts of lamellibran
ably Allorisma, Myalina and the like. The scattered
shale are generally sandy and almost equally unfos
Some few thin beds of carbonaceous shale occur; bu
crops invariably consist of disintegrated clay. The
erate bands are general local cross bedded layers of
less brecciated pebbles of very small size so that the
whole is rather a coarse sandstone than a conglomer

The Richland Sandstone division is terminated a
conglomerate which I have called the Rochelle con
bed. This bed which starts near the Rochelle pos
McCulloch county, has been traced northeast f
twenty miles, becoming finer grained in this dire
where it is buried beneath the Cretaceous being a co
stone with cross bedded layers of fine grained con
This bed is of interest for several reasons. It is an
of progressive change in the texture from course to
from southwest to northeast, quite the reverse of wha
in the beds above. The point of origin is plainly
eastern Silurian, since all the pebbles are flint from t
a careful search failing to reveal any other pebbles
is the nearest point of approach to the Silurian of
beds of the Richland division in this area. Near
rests on an eroded base of lower Carboniferous, a fe
feet thick geologically and as many yards horizont
on the Silurian, which is at this point a headland.

b. Milburn Shales.

Above the Richland division is the division of t
shales, a series of alternating sandy shales, clay
[illegible] shale with thi

The total thickness of the next division, the Brownwood division, is not far from 1300 feet, chiefly (in the southern part) of limestone. On the southern portion there is one band of sandstone 25 feet thick and the remainder of the section is limestone. Much of this limestone is pure and free from foreign particles, particularly in the southern portion, but there are several bands of impure limestones with a considerable admixture of clay and in places even of sand. These beds which are marked by a dark brown rust on the surface, when traced northeastwards merge into beds of sandstone. At Brownwood there are six or eight beds of sandstone in the series instead of only one, twenty miles south of that place. It seems certain that there must have been a place of origin for this sand somewhere east or northeast of Brownwood. Beds of conglomerate in this division contain medium sized pebbles of flint resembling that in the Silurian more than thirty-five miles south of their present position, and it seems unlikely that they have been transported that far.

d. Waldrip Coal Division.

The Brownwood limestone division is followed by a series of shallow water deposits chiefly of fine sediment. This, which I call the Waldrip Coal Division, is the chief coal bearing series of the section. The lower beds are sandstone containing several thin beds of limestone. These beds, which in the southern portion are nearly two-thirds limestone, become progressively more sandy to the northeast until west of Brownwood they are fully two-thirds sandstone.[*] This thickening of the sandstone and disappearance of the limestone away from the known land area is suggestive; and more so, when, far removed from the present known Silurian, are beds of conglomerate with pebbles of Silurian flint. The beds above the sandstone are the typical coal bearing shales and clays 300 feet thick, with one seam of coal seldom thicker than twenty-four inches, and sometimes locally divided into several seams by clay partings. These beds are particularly rich in fossils of the coal series, but no detailed paleontologic study has been made. All the limestones of this and the other divisions are rich in animal remains, and in the carbonaceous shales the flora is well represented.

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[*] A detailed stratigraphic description of this and the other divisions will appear in the forthcoming Second Annual Report of the Texas Geological Survey.

clays and shale. The clay
variously colored clays, (red, yellow, white and blue
shales, sandy shales and thin beds of clayey
The aggregate thickness of these strata rarely exc
than fifty feet in any one series, and both above and
almost invariably be found a thick bed of limes
limestones of this division are adulterated with cl
an extent that it is somtimes difficult to assert th.
is a limestone. Accompanying this lithological fe
faunal peculiarity due to the condition of sediment
true limestone fauna consisting of Aythris and the l
generally absent, and is replaced by lamellibrancl
Allorisma and Myalina and some of the clay-dw
teropods. Large species of Productus and Spirife
times abundant, but the delicate species that lived i
water at the time of deposition of the Brownwoc
rarely observed. An occasional bed of sandston
and these beds become more numerous to the nortl
likely when the strata of this division are traced fu
eastward sandstone beds will be much more freque
have a greater thickness.

III. SUMMARY.

The history of the Carboniferous system as brie
on the preceding pages commences with the dep
considerable thickness of lower Carboniferous lime
old shore of Silurian land. An interval accompa
elevation, a small amount of disturbance, and pro
erosion, is followed by the opening of the upper Ca
Forty-five hundred feet of sandstone, shales and c
included in the Richland division probably re
Millstone grit. Followi

division, a period of limestone deposit in the southwest, but of more sandy beds to the northwest, which seems to point to the presence of an old land area near there, which is now hidden from view beneath the Cretaceous. The last beds of the Brownwood division indicate a return to shallow water conditions, and this is followed by the coal bearing shale beds of the Waldrip division. Following this is the deposition of alternating clays and limestones, containing much clay and a consequent change in fauna. The conditions of this deposit seem to indicate that the then shore line was in the Carboniferous, and that the Carboniferous beds previously deposited and unconsolidated were in part furnishing sediment for the forming strata. The Permian conditions are probably being approached, and possibly even at this time the basin of deposit has become a partially enclosed sea. A gap of unknown extent ensues after the close of the Permian until the beginning of the Lower Cretaceous which buried the Palæozoic rocks, now by erosion partially uncovered for study.

ON THE GLACIATION OF THE NORTHERN PART OF THE CORDILLERA, WITH AN ATTEMPT TO CORRELATE THE EVENTS OF THE GLACIAL PERIOD IN THE CORDILLERA AND GREAT PLAINS.[1]

By George M. Dawson, LL.D., F.G.S.
Assistant Director Geological Survey of Canada.

Broadly viewed, the Cordilleran region of British Columbia and the adjoining part of the Canadian Northwest Territory to the north of that province, may be said to constitute an elevated mountainous zone bordered by two dominant ranges—that of the Rocky mountains proper on the northeast and that of the Coast ranges on the southwest. The width of this zone is about 400 miles, and on one side of it lies the wide area of the great plains, on the other the Pacific ocean together with a partially submerged outer mountain-range of which Vancouver island and the Queen-Charlotte islands are projecting parts.

In a communication which has already appeared in this journal,[2] the writer has briefly outlined the principal observa-

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[1] This article may be considered as a partial abstract of a paper read by the author before the Royal Society of Canada, May 29th, 1890.

[2] Vol. III, p. 249.

cordance with which he has been led to believe that
f the Cordillera of the West was, in the Glacial
ered by a great confluent glacier-mass. Evidence
tence of the southern part of this great ice-mass
early stage in his investigation of the glacial phe-
the region, obtained in the corresponding part of
r plateau of British Columbia; and though doubts
t entertained as to the mode by which the traces of
as distinct from the local, glaciation of the region
xplained, these were solved at a later date.[3] Still
riter was enabled, while engaged in an exploration
on district, to find evidence of the northwestward
f the same confluent glacier and approximately to
its limits in that direction. Having thus surround-
of this great glacier, it was proposed to name it the
n *Glacier* in order to distinguish it from the second
ice-cap by which the northeastern part of the con-
at the same period more or less completely covered.[4]
lilleran glacier, as thus defined, had, when at its

plies that the ice reached a general thickness of 2000 to 3000 feet above even the higher tracts of the plateau, while it must have attained a thickness of over 6000 feet above the main river-valleys and other principal depressions of the surface.[5]

The existence of this great Cordilleran glacier is naturally the first event of the period of glaciation of which evidence has been found in the region, as its ice-mass was competent to remove all signs of the more local growing glaciers which must have occurred during the early stages of the period of cold.

The object of this paper is to sketch briefly, in the first place, the subsequent history of the events of the Glacial period in this part of the Cordillera, and in the second, to endeavor to show in what way these events may be connected with those of the same period found on the Canadian great plains. In so doing it will not be possible to pursue the inductive method by which the propositions here stated have been reached, nor even to do more than to refer to the nature of the evidence upon which the various statements are based. Much of this evidence has however already been published in several papers written during the past fifteen years, and a summary of that which has not yet been made public is contained in a forthcoming more detailed memoir on the same subject. For this reason, the writer feels that he must claim the indulgence of the reader to some extent, in here advancing hypotheses without adequate proof, and without even giving in detail the reasons which have led him to modify suggestions already made by himself at various stages in the investigation.

During the maximum of the Cordilleran glacier, it appears that the Cordillerian region stood at a considerable higher level than it now does, while an important part at least of the great plains was depressed to such an extent as probably to admit waters in connection with, and at the level of those of the sea. The eventual retreat of the Cordilleran glacier was contemporaneous with, if not caused by, a subsidence of the mountain region.

The first effect of the decay of the great glacier appears to have been the production of lakes upon its surface or within the central part of the southern portion of its area, in

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[5] These statements depend in part on facts published in the Geological Magazine, August, 1889; in part on additional evidence yet unpublished.

ely dry region of the interior plateau. Along the
one or more such englacial lakes, terraces, composed
l resembling boulder-clay, were formed on projecting
[6] The best marked and highest terrace to which
is attributed, has an elevation of about 5290 feet
present sea level, and this terrace, (or others at or
level,) has now been recognized in a number of
uch englacial lakes continued to increase in size and
lower in level, for some time, while the general sub-
so progressed. There is also some evidence to show,
the final draining of these lakes and as the great
reated from the interior plateau, it was followed by
deepening water which was in communication with
sea. The boulder-clay deposit of the interior plat-
eved to have been formed during this retreat, at, or
ontiguous to, the retiring ice-front. The lower boul-
f the littoral was laid down under similar circum-
ut at a somewhat earlier stage in the glacial deca-

of some size, the land remained nearly stationary for a long interval, and remarkable and important silt deposits, well bedded and of considerable thickness, were tranquilly laid down in different low tracts scattered along the Cordillera region for a length of about 1200 miles. These deposits, the writer has in previous publications referred to as the *White Silts*, and as observations accumulated, it at length became evident that these silts possess more than a local significance. They appear in fact to constitute a well marked formation, characterizing a definite and long maintained stage of stability in the glacial history. In the various more or less completely separated basins in which they occur, their level is so nearly identical, as apparently to show that this must be referred to a common cause, which it is believed, in consideration of all the circumstances and particularly in view of the vast area which the observations here referred to cover, can have been no other than the elevation of the sea at the time. No morainic or other accumulations have been found such as to account for the production of lakes in which these silts might be supposed to have been deposited, and had they been formed in separate lakes held in either in the manner suggested or by glacier-dams, they would, in a region of such bold relief as the Cordillera, be expected to occur at different levels in each basin.[1]

The level which is obviously the important one in dealing with this subject, is that of the upper limit of the main White Silt deposit in each basin, and in order to present the salient facts of this important episode in the glaciation of the Cordillera, the significance of which is here for the first time pointed out, the general result may be given as in the subjoined list.

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[1] The occurance of two such areas at the same level, under the circumstances, might be characterized as a remarkable coincidence, of three as an extraordinary coincidence and if several as a coincidence of an astounding character, unless under the influence of a common cause as here suggested.

[2] In classing together the principal occurrences of silty deposits of the Cordillera, under the name of the White Silt formation, it should be noted that the silts so included are not the only ones of the region. Occasional small and local occurrences of silts at considerably higher levels, are found, and some of these are known to be due to glacier-dammed lakes of an earlier stage. The lower level of the White Silt formation, is also to some extent indefinite, as it is probable that some portions of it were deposited in relatively deep water, while in other places, rearranged silts have since been formed at lower levels, and these it is not always possible to distinguish from those of the original main deposit.

l upper level of the White Silt formation in various points of the Cordilleran region.

District.	Normal highest level in feet above sea, of main silt formation.
ootanie valley, between Rocky mountains ld ranges. (Opens to the south.)	2700.
art of Interior Plateau. Silts here chiefly d to main valleys. (opens to the south and Pacific.)	2500.[10]
art of Interior Plateau. Silts here cover an about 1000 square miles. (Opens to Peace lains and to the south.)	2400.
r Plains. Silts here cover surface of plateau inage basin of Mackenzie river.)	2500.
ey of Stikine. (Opens to Pacific.)	2200 to 2300
d Basin. (Opens to Mackenzie.)	2400.
on Basin. (Drains to Behring sea.)	2700.

terial of the White Silts was evidently afforded by owing from adjacent glaciers, the approximate limits t the time are shown by the termination of the Silts

It is worthy of note, that most of the long fiord-like lakes of the mountain regions of British Columbia, can be shown to occupy portions of the abandoned beds of the glaciers of the stage of the White Silt formation. To the elevation which began about the time at which we have now arrived, the draining of the White Silt basins, together with the formation of all the lower-level terraces, is supposed to be due. There appears, however, to have been one well marked pause, during which the littoral, at least, was at a hight about 200 feet lower than it now is, and there is in addition some evidence of a succeeding movement in elevation of several hundred feet, which, if it occured, constitutes the last important change of the kind in the region.

Having elsewhere discussed the glaciation of the great plains at some length,[13] the writer may now without attempting any further description of the phenomena which they present, offer the subjoined comparative scheme of events in the areas of the plains and the Cordillera respectively. Under this scheme, he has endeavored to include all the known facts and to deal with these in the light of personal familiarity with the greater part of both regions, and while it can scarcely be hoped that this scheme, here tentatively presented, will be found to stand the test of further investigations in all its details, it is believed that it may at least be accepted as indicating the mode in which the facts met with must be explained. In explanation of the fundamental idea involved in this comparison it may be premised, that already in Tertiary times some evidence is given of correlative phases of elevation and depression as between the Cordillera and the great plains, and these, it is believed, may have culuminated in a series of important correlative movements during the Glacial period, in which the plains were in a position more or less exactly complementary to the Cordillera. The general application of such correlative movements in the Glacial period, has lately been forcibly advocated by Mr. Warren Upham[14], and appears to the writer to hold

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[12] Cf. Canadian Naturalist, February 1878.

[13] Geology and Resources of the 49th Parallel, Chapters IX and X; Quart. Journ. Geol Soc., Vol. XXXI p. 603., Vol. XXXVII, p. 276; Report of Progress Geol. Surv. Can., 1884-85, p. 139 C. See also R G. McConnell, in Ann. Report, Geol. Surv. Can., 1885, Part C., and J. B. Tyrrell Ann. Report Geol. Surv. Can. 1886, Part E.

[14] Wright's Ice Age in North America. Appendix A.

Cordilleran zone at a high elevation. Period of most severe glaciation and maximum development of the great Cordilleran glacier.	mergence of the gre possible contemp creased elevation of axis and maximun of ice upon it. De lower boulder-clay
Gradual subsidence of the Cordilleran region and decay of the great glacier, with deposition of the boulder-clay of the interior plateau and the Yukon basin, of the lower boulder-clay of the littoral and probably also, at a later stage (and with greater submergence) of the interglacial silts of the same region.	Correlative elevat ern part, at least plains, which was or less irregular a production of ext which interglacial cluding peat, were
Re-elevation of the Cordilleran region to a level probably as high as or somewhat higher than the present. Maximum of second period of glaciation.	Correlative sub plains, which (at l ern part of the re the first subsiden submergence to t Rocky mountains parallel. Forma boulder-clay, and dispersion of large
Partial subsidence of the Cordilleran region, to a level about 2500 feet lower than the present. Long stage of stability. Glaciers of the second period considerably reduced. Upper boulder-clay of the coast probably formed at this time, though perhaps in part during the second maximum of glaciation.	Correlative el plains, or at least portion, resulting of equilibrium plains and the *relative* levels bec at present. Pro of the Missouri shore-line durin rest.
Renewed elevation of the Cordillera region, with one well marked pause, during which the littoral stood about 200 feet lower	Simultaneous great plains to a level, with fin waters in connec Lake Agassiz for ally drained tow this period. T

set forth, it may be admitted on *à priori* grounds as not improbable that such conditions of oscillation once initiated, in consequence of the interaction of whatever forces, might have a tendency to repeat themselves several times before a stable condition was regained,—a state of equilibrium being in the end attained either by the general decrease in intensity of the operating causes, or by the final ascendency of one class of these. It may also be pointed out that the supposed sequence of events is generally in accordance with the view that the epochs of maximum glaciation of the Cordillera, were those of its greatest elevation, while the decay of its glaciers was in both instances accompanied, if not caused, by subsidence leading to the encroachment of the oceanic waters. The supposed flooding of the great plains (the glaciated portion of which lies almost entirely in the Arctic basin) by cold northern waters, while the Cordillera stood as a much elevated land between these and the warmer waters of the Pacific, in itself goes far to explain the conditions under which the excessive precipitation required for the production of the Cordilleran glaciers might occur.

The sequence of events here advanced is furthermore compatible with the belief that the weight of a ponderous ice-cap may alone be sufficient to produce subsidence of the land, and with the idea that such an ice-cap may thus eventually become self-destructive, by obliterating the elevation to which its existence is in the first instance largely due.

Though independently based upon, and primarily intended to include the observed phenomena of the Glacial period in the northwestern part of the continent alone, it is also worthy of remark, that the elevation believed to have affected the Canadian plains during the interglacial episode, is to some extent confirmed by the fact that Messrs. Chamberlin and Salisbury find evidence of a similar upward movement of the upper Mississippi valley at a corresponding time, to an amount of about 1000 feet.[11] It is further noteworthy that the two great correlative movements of elevation of the Cordillera and depression of the great plains here admitted, correspond in a general way with the principal similar, though less considerable, changes in level, which are accepted by Mr. W. J. McGee as explaining changes which affected the region of the middle At-

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[11] Sixth Annual Report U. S. Geol. Survey, p. 214.

ope, and indicated there by the Columbia formation.[15]
e case of the great plains, both changes in level were
the sense of depression, followed by re-elevation, but
ay believe that depression in one region is made up
levation in another, the only important point to which
n need be drawn, is that both maxima of glaciation,
Pacific as well as on the Atlantic side of the continent,
ncident with considerable disturbance in level.

y be added in conclusion, that it is now distinctly
as the result of work done under the auspices of the
al Survey of Canada, and more particularly of obser-
by the writer and his colleagues, Messrs. McConnell
rrell, that the extreme margins of the western and
glaciated areas of the continent barely overlap, and
y to a very limited extent, while the two great centers
rsion were entirely distinct.[16] For numerous reasons
an not be here entered into, the writer does not con-
probable or even possible that the great confluent

The exposures of Laurentian gneiss, forming the whole of the eastern and northern sides of Georgian bay, as far as the village of Killarney, are remarkably free from regular dikes. There were noticed however, two occurances of an apparently irruptive rock of much interest: a small bare island just above the water, four miles north west of Bushby inlet, is formed of a dark massive rock, very different from the gneiss of the surrounding islands. Under the miscroscope it is seen to consist largely of a deep green strongly pleochroic hornblende, in exceedingly irregular crystals or leaf-like aggregations. The centres of the crystals appear of a dull color and are rendered nearly opaque by thickly clustered minute grains of magnetite arranged along the cleavage lines of the former augite crystals. Large grains of magnetite are associated with the hornblende as, also, are numerous biotite leaflets and garnets: these are all embedded in a water-clear granular matrix of quartz and indistinctly twinned feldspar.

A little north of Bing inlet occurs another rock of similar aspect, cutting the gneiss in an irregular manner. Under the microscope this shows a very interesting character, and though the constituents appear to be secondary, yet its derivation from a diabase is evident, and illustrates how completely the primary minerals may be removed and yet their form preserved. Garnet, magnetite, mica, quartz and epidote are the most important constituents; Dark, nearly opaque, masses polarizing in deep blue and purplish tints and allotriomorphically developed are decomposition products of augite. Penetrating these dark masses are angular spaces exactly corresponding in form and arrangement to labradorite crystals in diabase, and filled with paramorphs of garnet aggregates. The open spaces between the alteration products of augite are filled partly with elongated rectangular aggregations of garnets, and partly by granular quartz, epidote, mica, and aggregations of green microlitic bodies. In many of the garnet aggregates are quartz grains and an interlacing net-work of green microlites. Lines of garnet surround all the dark augite alteration products and mica and garnets border the large irregular magnetite grains; scales of mica are often enclosed in the magnetite.

Three miles east of Killarney, near the junction of the quartzite with the Laurentian gneiss, appears the first unmistakable dike intercalated with a fine granulite whose strike

augite within the plag
ultaneously for on revolving the stage light and
across from one side to the other or from t
ward. The augite shows polysomatic crystals;
netite presents crystalline outlines suggesting, t
means proving, it to be primary.

Five miles westward on Badgely island, a di
the same microscopical character intersects a
in an east and west direction; this may be a c
the one just described though somewhat wider ar
its southern edge two narrow dikes; one a foot
three feet. This dike illustrates well the the u
of a mass irrupted through a cool rock: it i
centre, much broken into rectangular blocks by j
while at the sides it is aphanitic.

For sixty miles no more normal diabase
Numerous altered diorites are met along the
islands. Some are only a few feet wide, othe
across. These extend more or less continuo
from Cloche island, forming the whole or simpl
sides of many of the chain of islands as far
miles beyond Spanish mills. This altered dio
an occasional narrow branch intersecting quartz
or in its great mass, exhitits a remarkable uni
whole extent, showing quite uniform compositi
degree of alteration. The main body is interc
schists which have a very constant east and
vertical dip. Between this irruptive rock
schists is usually a dark, soft layer of chlorite
evidently from movement and pressure. In
were the strike and dip of the country rock r

Microscopic examination of sections from various portions of this great eruptive mass as well as from several narrow dikes east of Cloche island shows in most instances a highly decomposed diorite. In only a few instances is there any appearance of the derivation of the hornblende or the chlorite, into which it is largely decomposed, from any preëxisting augite. A section from a narrow dike in the granite a little north of Killarney shows a micaceous diorite containing much brown mica; some uralitic hornblende, the rest bleached and fibrous with dark green borders; small twinned plagioclase crystals; granular epidote, and pyrite. The mica scales and green hornblende are often mixed indiscriminately.

Another narrow dike, in sericite schist on the long peninsula south east of Cloche island, under the microscope shows a uralitic hornblende schist. The hornblende crystals polarize in deep green to yellowish tints, are irregular in outline and terminate in long actinolite like fibres. The fine granular matrix between the large crystals is filled with similar long green fibres, mica scales, and a little magnetite. Basal sections show hornblende cleavage. In the centre of the large crystals are dull circular spaces dotted thickly with granular magnetite, traces perhaps, of preëxisting augite. Sections from two dikes south-west of Wallace mine, exhibit a pale green chloritic hornblende, granular in the centre with bright green fibrous edges; magnetite grains dot the cleavage cracks, and the feldspar crystals are largely clouded. A dike intersecting a high quartzite knob contains a large proportion of deep green, fibrous hornblende, similar to the uralitic hornblende schist just described. The feldspar is dotted with aggregations of granular epidote; and ilmenite in small opaque granules with cloudy (leucoxene?) borders is present in small quantity. The next half dozen sections are taken at intervals from the extensive exposure of massive diorite, before described as forming a large part of the islands for so many miles. These sections are so nearly alike that one description will do for all. In the most of them, alteration has proceeded so far that simply a confused mass of secondary products appears. The viriditic or chloritic constituent, in irregular, pale green or almost colorless crystals, represents former hornblende; judging from numerous basal sections. These bleached fibrous crystals show such an indefinite character it is often difficult

bright, orange red granules of
be determined are rutile. There is also some secc
and orthoclase.

A very peculiar vein or dike occurs in the diori
west of Spanish mills. Thin sections shows it
ceous pyroxene schist exhibiting the following
rhombic pyroxene, biotite, quartz, magnetite,
serpentine. The pyroxene crystals show strong
are very much broken, irregular and somewhat a
the cleavage is indistinct, yet the general appea
of hypersthene. Numerous large scales of mica
good condition and partly altered to a brownish
almost amorphous substance, full of numerous o
and grains. Fine granular quartz forms the bod

About eight miles west of Spanish mills grani
again take possession of the shore and islands. On
northwest of Bird island appear several elongate
masses of diorite enclosed in granite. They hav
fresh appearance. A strongly pleochroic hornb
well formed crystals is mingled with about an
of plagioclase and a little magnetite and quartz.

A dike of typical olivine diabase, three hund
appears to the westward. It lies in an east and
and is intercalated with gneiss. To the naked
not be distinguished from the diabase exposure
but under the microscope is seen to vary somew
gite is in almost perfect condition and as usu
morphically developed, exhibiting pale brownis
double refraction and rough section surfaces.
show beautiful twinning and are sometimes en
in the augite. Many of the crystals show exti

granular, is scattered over the section; many of the grains are undergoing decomposition on their borders into green serpentine and magnetite.

A narrow diorite dike west of Cook's mills shows a complete alteration similar to that before described. Basal hornblende cleavage is often shown in the chlorite.

On a series of small islands, two miles west of Algoma Mills another completely altered diorite appears which contains some secondary quartz and orthoclase, as well as the usual decomposition products. Another dike similarly decomposed just east of Blind River mills, is characterized by a large amount of leucoxene containing stringy portions of ilmenite.

The four following sections are from one of a number of similar dikes extending in a direction a little south of west from Blind river and forming the back bone of a number of islands. These sections exhibit the usual variation between a coarse centre and an aphanitic edge. The two sections taken from nearest the centre and the one from the edge are completely altered. The feldspars are represented by cloudy aggregates, and the augitic constituent by a confused mass of pale green or yellowish appearance, bordered in places by green hornblende. There is also much granular magnetite and leucoxene. The fourth section, taken a few feet from the edge is not so much decomposed and gives the key to the original composition of the whole mass. Decomposition, as with the others, has formed much dirty green matter, magnetite and a clouding of the feldspars. But the centres of many crystals of augite appear in good condition, showing basal cleavage and usual polarisation colors. The dike cuts across the strike and bedding of the quartz schists at a small angle, lacking about twenty degrees of being vertical.

Contact metamorphism of the schists is finely illustrated by their vitrification for several feet on each side.

The shore line from this point to within about three miles of Thessalon, a distance of perhaps twenty-five miles, is occupied by a granitoid rock, containing in many places angular inclusions of foreign material which together with a sort of flowage structure presents the appearance of a semi-eruptive mass. Narrow dikes occur at short intervals and as a general thing lie in a direction approximating east and west. About four miles west of the mouth of Blind river, a large irregular-

ed mass of diorite seems to have broken through the
nd in places the red coloring matter of the latter is
vith the eruptive rock. Sections from the various
show, as usual, a high state of alteration. In one in
the forms of the feldspar crystals are scarcely dis-
while distinct, four to six sided crystals of chlorite
s of granular epidote, seem to be paramorphs after
le.

ctions of dikes a little to the east show very distinctly
of pressure in the broken and crushed feldspar crys-
cracks are filled with chlorite. One of the sections
ystals of leucoxene altered to titanite. Proceeding
toward Thessalon the various dikes met, with few
s, are greatly altered, and exhibit a very similar ap-
In some there is a deep uralitic hornblende; in
is chiefly viridite; a little magnetite or ilmenite
oxene and rutile often appear; and occasionally apa-
es. One dike deserves mention as it contains horn-
hich has every characteristic of primary origin be-

character, reminding one of the lava overflows of the western states. Near the eastern border this mass presents a jointed and somewhat slaty appearance. And a mile east of Thessalon, portions are so soft as to resemble chlorite schist. The amygdules are usually calcite, epidote, or quartz. The quartz is not often amorphous but in fine granular mosaics, with the grains arranged concentrically around the cavity; the coarser in the middle. Some of the larger cavities contain agates. Angular or rounded fragments of felsite and granulite stand out distinctly in numerous places. Rounded pebbles of clear quartz, several inches in diameter, occur frequently, presenting no signs of secondary origin. At one spot a more modern dike cuts this old eruptive formation. It is fresher looking but contains the same constituents.

Ten sections made from various portions are almost identical in composition though they show considerable variation in the degree of alteration and in texture. The components are not distinguishable to the naked eye, but under the microscope show minute interlacing crystals of plagioclase usually clouded; and alteration products consisting of chlorite, viridite, epidote, calcite, and sometimes mica and leucoxene. Two sections show a microfelsitic texture; and in one are large crystals of feldspar of previous generation.

Whether the original state was that of a melaphyre or basalt, it is impossible to say. Logan applies the term "chlorite slate" to this mass of rock, which is very misleading, for it is plainly a lava overflow with no traces of stratification.

Quartzite is met again a short distance west of Thessalon and on several islands it is intersected by dikes having an east and west direction. The first is a coarse diabase much altered, the augite being mostly changed to uralitic hornblende, mica and viridite. The feldspar crystals are largely clouded; the unaltered portions show successive extinction similar to that noticed in diabases farther east. The magnetite is usually surrounded by a layer of biotite mica. A section from the edge of this dike shows lath-shaped labradorite in good condition, and much magnetite and alteration products. On an adjoining island, appears a dike quite similar to this, though not so much altered; the augite is in polysomatic crystals, and often bordered by green hornblende. One of the largest crys-

gular [illegible] of q
erable portions of the section, penetrate a decon
or other alteration products like epidote and
tions of the section contain uralitic hornblend
like highly altered diabase.

A very fine aphanitic dike six inches wide in
tered diorite a little farther westward on the m
der the microscope appears a net work of interl
minute and acicular plagioclase crystals witl
These are imbedded in a micro-felsitic matrix w
ed nearly black by minute opaque grains.

Five miles west of Thessalon is an altered di
old diabase. It cuts across the strike of the q
east and west. It is somewhat schistose in tl
its length. It has rendered the quartzite bedde
direction for at least ten feet away. This sla
the quartzite is so pronounced that in weath
off in slabs parallel to the dike. That a great st
ment took place subsequent to the time of inje
by the presence of a breccia, five or six feet wi
dike. It consists of a mixture of angular fr
eruptive rock and of the quartzite, imbedded
quartz and chlorite.

Beginning a short distance west of this poin
islands are formed of a dark massive rock, an
of coarse texture. A thin section shows a du
in which the form of the greenish plagioclase
distinguished. Some quartz containing apati
a pegmatitic structure. Most of the alterati
of such an indefinite character that they cann
This rock extends as far as the Bruce mine

roglyphic-like quartz lamellæ. The lamellæ penetrating any one crystal of feldspar have the same orientation, while those penetrating different crystals have different orientation; green chloritic hornblende dotted with magnetite, forms irregular masses and in some cases seems to penetrate the feldspar in a manner similar to that of the quartz. Apatite needles are thickly scattered through the quartz.

On the islands east of the lower end of Sugar island, are a number of dikes extending in a northwesterly direction. They were probably all originally diabase. All degrees of alteration are visible in the sections, from those still showing a fair condition of the augite and feldspar to those in which the alteration products form an almost indeterminable mass.

Distinct types of eruptive rocks along the north shore are very few. A large number of the dykes are evidently diabase; many are alterations from that, or an allied type; and some appear as either normal diorites or alterations from that type. In addition, there are some of basalt or melaphyr.

An interesting feature about the main dikes is the general east and west direction. Whether this is due to the strike of the schists offering the least resistance in their bedding planes or some line of strain in accordance with which their directions were determined, it is impossible to say.

The large exposure of eruptive rock east of Thessalon is evidently an old overflow, judging from its uniform fine texture and often amygdaloidal character. The other two large areas of eruptive rock give no evidence of surface consolidation, appearing simply as enormously expanded dikes. The scoriaceous character of parts of the Thessalon eruptive seems to indicate that, either, our generally conceived notions of the great amount of pre-glacial and glacial erosion are exaggerated or what is more probable, as suggested by Dr. Lawson, palæozoic sediments have covered portions of the Archæan rocks, and preserved them from erosion, and in this region, perhaps, till the glacial period, for it is but a short distance to the Silurian rocks which form the islands in the channel.

One of the most difficult problems for solution, in the study of these ancient eruptive rocks, is the determination of their original constitution and the genesis of the present altered forms. The dikes are probably all of Archæan age. They are at least pre-Silurian for the limestone which, in many places,

en resting upon the quartzite or gneisses is not at all
d. The dikes showing the greatest degree of altera-
r, both in the Huronian quartzite and siliceous schists
aurentian gneiss, while the freshest and most per-
nples met were in the Laurentian gneiss.

ttribute the very great amount of alteration, exhibit-
extensive body of massive diorite in the vicinity of
Mills to crushing or deformative forces or penetrating
must separate its origin in time from the unaltered
in the immediate vicinity, by an immense period,
for the conversion of augite into hornblende and
nblende into viridite. And these forces must have en-
sed before the injection of the unaltered diabases.
hardly believe in such a sequence of events for some
eruptive, for example the mass of diorite just men-
From microscopic examination and field relation
ears no clue to the action of those forces, which is
have usually brought about the alteration, during
of the strata, of narrow or interbedded masses of trap
o great extent. It seems to me we can attribute to

NEW LAMELLIBRANCHIATA.

By E. O. Ulrich, Newport, Ky.

No. 2, On two new genera and six new species.

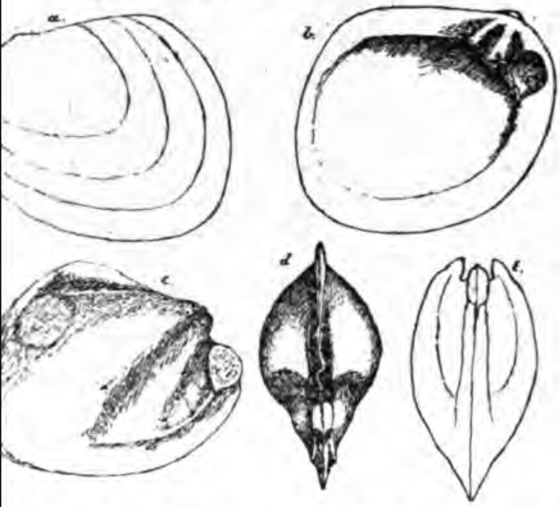
Ischyrodonta, n. gen. [Ety. *ischyros*, strong, *odous*, tooth.]

Short or elongated, thick bivalve shells, having small subterminal beaks, with the hinge straight or slightly arcuate and extended posteriorly. Hinge plate wide and strong, without posterior lateral teeth, but with a strong cardinal tooth in the left valve and two nearly as strong in the right. Just in front of them a pair of subcircular large and deep anterior muscular impressions, and between these and the teeth another very small pair. Posterior scar large but faintly marked, ovate, situated in the postero-cardinal region. Pallial line simple. Ligament probably internal.

In casts of the interior the beaks are prominent and compressed, and a well defined sulcus, representing a ridge-like internal thickness of the shell, extends from the umbones more than half the distance to the basal margin. Type, Ischyrodonta truncata, n. sp.

The internal casts of the two species of shells for which the above generic name is proposed, remind one of both *Cypricardites* Conrad,and *Modiolopsis* Hall,the position of the new genera being, perhaps, very nearly intermediate between these two genera. From *Cypricardites*, which they resemble the most in the general form, thick shell, and wide hinge plate, they differ in having no posterior lateral teeth. The cardinal teeth are also less numerous, stronger, and differently arranged. From *Modiolopsis*, of which they likewise resemble certain species in their general aspect, they differ in having a thicker shell, wider hinge plate, and much stronger cardinal teeth. In true *Modiolopsis* there is only a mere thickening or slight fold of the hinge plates beneath the beaks, yet I do not think that the plan of hingement is fundamentally different from that of *Ischyrodonta*, in which I believe it has simply found more full expression. The small accessory scars situated just above the anterior adductors, are not, as far as I am aware, ever present in either *Modiolopsis* or *Cypricardites*.

Ischyrodonta truncata, n. sp.



Ischyrodonta truncata, n. sp., Cincinnati group, Oxford, on the exterior of the shell. Another but less deep and shorter furrow occurs in the space between this and the anterior muscular scar.

An average specimen of the typical form has the following dimensions: Greatest length, 35 mm.; greatest hight, (from posterior extremity of hinge line to posterior portion of base) 30 mm.; from postero-cardinal angle to antero-basal region 31.5 mm.; from beaks to postero-basal region 35 mm.; greatest convexity of a cast of the interior of a specimen of the same size, 16 mm.

This species ought not to be confounded with any other known to me from the Cincinnati rocks. I have seen specimens of it labelled *Cypricadites hainesi* S. A. Miller, a shell occupying the same horizon, but there is little reason for confusing the two since Miller's species has posterior cardinal teeth, is less convex, and not so high posteriorly.

Position and locality: near the top of the Cincinnati group at Oxford, O., and Richmond, Ind.

Ischyrodonta elongata, n. sp.

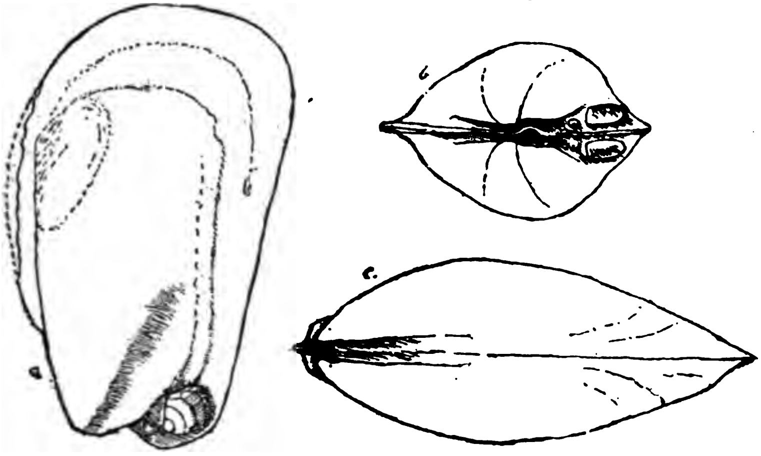


Fig. 12. *Ischyrodonta elongata*, n. sp., Cin. gr., Oxford, O. Three views of a large and nearly perfect cast of the interior of this species.

Of this species only casts of the interior have been seen. These may be described briefly as follows: Shell rather large transversely elongate-ovate, widest posteriorly, strongly convex, with point of greatest convexity a little in front of the

Beaks prominent, compressed, almost terminal.
margin convex; posterior margin rather strongly
and generally somewhat straightened in the lower
al margin straight or faintly sinuate; anterior end
rounded, very short. Anterior muscular scar deep,
ate, situated beneath the beaks. Just above it the
essory scar.

ich greater length of this shell distinguishes it from
a, with which it is associated. The outline is much
of *Modiolopsis modiolaris* Conr., but the casts of that
e not so convex and the beaks less prominent.

ted with this species and *I. truncata* I found several
of a form apparently intermediate in character be-
two. They are, unfortunately, not in very good
, but as far as they admit of comparison it would ap-
they represent nothing more than a slightly elongate
I. truncata.

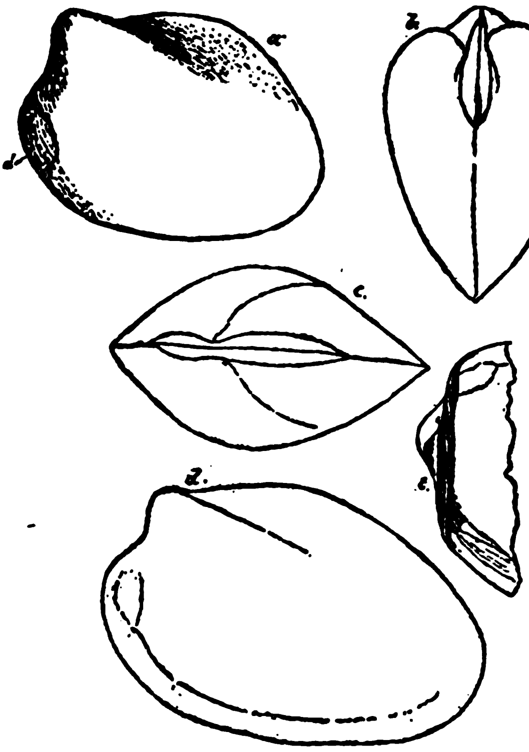
and locality: near the top of the Cincinnati group, at Ox-
d Richmond, Ind.

claims that *Dolabra* is founded upon inequivalve shells, having an edentulous hinge.

From *Cypricardites* (provisionally including *Cyrtodonta*) the new genus is totally different. All true species of that genus have thicker shells, a wide and strong hinge plate , and from two to four strong posterior lateral teeth. They have also no wide escutcheon as in *Whitella*, though a narrow striated ligamental area exists in some of the species.

The species which I would refer to this genus, besides those here described as new, are *Dolabra* (*Cypricardites*,) *sterlingensis* M. and W. (*Cypricardites quadrangularis* Whitfield, and (*Cyrtodonta hindi* Billings. At least four other undescribed species are known to me, two in the Trenton and Galena of Minnesota, one in the Trenton of Kentucky, and one in the upper beds of the Cincinnati group, at Waynesville, Ohio.

Whitella obliquata, n. sp.



Whitella obliquata n. sp. Cincinnati group, Blanchester,
n and Waynesville, Ohio, and Spring Valley, Minn., *a* left
st of the interior, preserving a small fragment of the shell
he specimen is a small one but of the normal form, *b*, and
and cardinal views of another, nearly perfect, cast of the
left side of another cast, the hight of which has been a lit-
by compression. *e*, partial view of the interior of a valve from
preserving the hinge teeth and faint muscular impressions.

rge, oblique, subrhomboidal in outline, produced in
o basal region, ventricose, with point of greatest con-
ve the middle ; beaks rather small, prominent, slight-
d, situated one fourth of the length of the hinge line
nterior extremity, umbonal ridge well marked, the
lope concave. Anterior end small, narrowly rounded
rging gradually into the evenly and only moderately
entral margin. Posterior end sharply curved and
below, gently convex and sloping forward in the up-
o meet the slightly convex, cardinal margin. Escut-
ll marked, wide, shallowest in front of the beaks.
muscular scar elongate. Hinge thin, the posterior
le, the anterior half, of the left valve, with two long
blique teeth just beneath the beak, and two shorter

tero-dorsal slope shorter and more abrupt, the hight comparatively greater and the outline in general somewhat different, particularly in the ventral region where the margin is more convex than in *W. obliquata*. *W. quadrangularis* (*Cypricardites quadrangularis* Whitfield) is much shorter and more erect.

In a large specimen the hight and length are respectively 47 mm. and 60 mm; in a small specimen 38 mm. and 45 mm. greatest convexity of the latter 25 mm.

Position and locality. Upper beds of the Cincinnati group at Blanchester, Middletown and other locations in Ohio and Indiana.

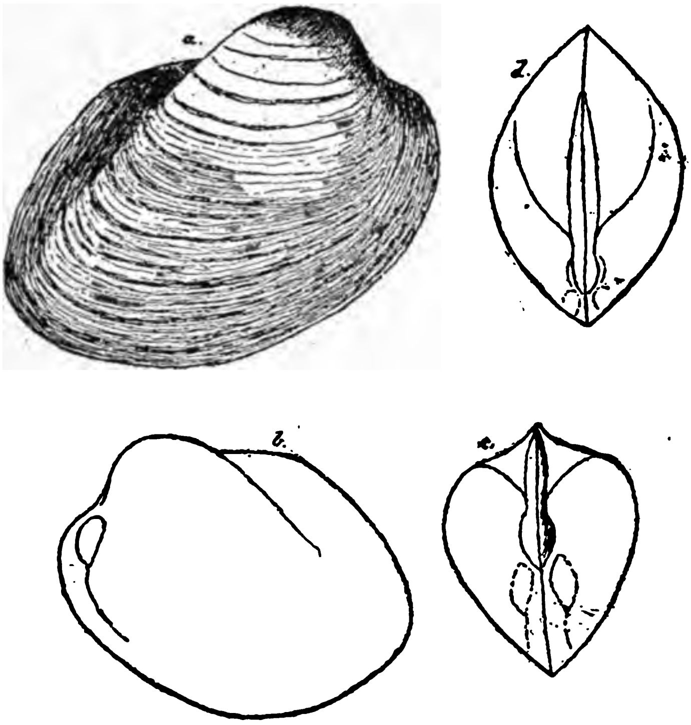
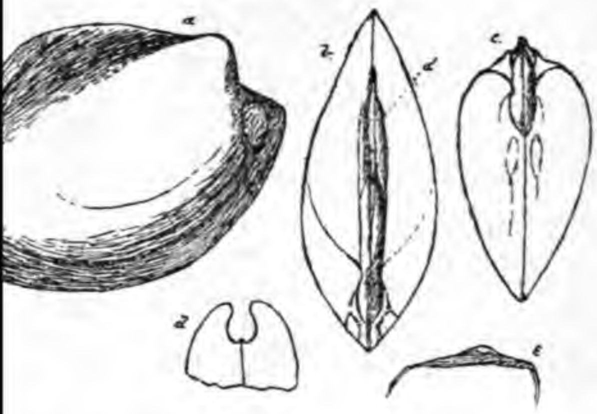


Fig. 14. *Whitella umbonata*, n. sp., upper beds of the Cincinnati group. *a*. View of the right side of a large example, taken from a gutta-percha cast of a natural mould of the exterior. *b*, *c*, and *d*, three views of a well preserved but small cast of the interior, collected at Middletown, Ohio.

Whitella compressa, n. sp.



Whitella compressa n. sp., Trenton shales, Minneapolis,
ight side of a cast of the interior; outline slightly restored. *b*,
iew of same, showing the impression of the internal ligament

Falls, Minn., which preserves the shell. This I now regard as belonging to a distinct species with a more distinct umbonal ridge, greater tumidity and less projecting beaks, thus in almost every respect agreeing more nearly with *W. obliquata.* Still it must be regarded as specifically distinct from that species since there is a well marked difference in the dentition of the hinge, the teeth in front of the beaks being shorter and less nearly horizontal. Additional differences are brought out by a comparison with the Ohio specimens of that species, such as greater convexity, more pronounced umbonal ridge, slightly less projecting and more closely approximated beaks. The escutcheon also is narrower, with its sides more nearly vertical, while the internal ligament support at the posterior extremity of the hinge is stronger. The form of the shell is besides somewhat different, being comparatively higher and more erect.

The basal margin and lower portion of the posterior end are unfortunately broken away on the Cannon Falls specimen, but so far as the evidence at hand permits of judgment it would appear that the postero-ventral angle is more abrupt than in *W. obliquata.*

Taking all these points into consideration I feel justified in regarding it as sufficiently distinct to deserve recognition. I propose therefore to call it *Whitella scofieldi* in honor of Mr. W. H. Scofield of Cannon Falls, Minn., to whom I am indebted for many favors.

EDITORIAL COMMENT.

THE PRE-NATAL HISTORY OF THE GEOLOGICAL SOCIETY OF AMERICA.

The movement for the Geological Society was inaugurated at Cincinnati, Ohio, in 1881. The following are the official records:

> The geologists of the American Association for the Advancement of Science, at the Cincinnati meeting, at a meeting held in the room of Section B, 5 p. m. Aug. 18, 1881, having resolved to organize an association of the geologists of America, appointed a committee to draft a constitution and organization of such society. This committee consisted of the following members:
>
> George C Swallow, Columbia, Mo.

Winchell, Minneapolis, Minn.
Miller, Cincinnati, Ohio.
J. Davis, Louisville, Ky.
Collett, Indianapolis, Ind.
Williams, Ithaca, N. Y.

ommittee met at the close of the meeting (of Section B.) with
inchell as chairman, and appointed H. S. Williams, Secretary,
r some consultation it was agreed that S. A. Miller be re-
to draft a constitution for the consideration of the committee
xt meeting.

rned.

cond meeting was held at 9 a. m. Friday, Aug. 19th. Present:
l, Miller, Davis, Williams and Swallow. Miller presented the
g preamble and constitution:

EAS, The geologists of America are without any central organi-
there is no place for them to assemble for the discussion of
questions, and no publication which they can call their own;
erefore, in order to bring them together in an association for
ual benefit arising from such discussion and to found a publi-
levoted exclusively to their services, we do establish this
under the following constitution:

PROPOSED CONSTITUTION.

CIRCULAR LETTER TO THE GEOLOGISTS OF AMERICA.

At the Cincinnati meeting of the A. A. A. S. (August 1881) the geologists there present met together to consider the propriety of forming a separate organization promoting their mutual interests in directtions not fully met by the A.A.A.S.

The demand for more uniform and united work by geologists throughout the country and for means of coöperation and intercommunication among such workers appeared to those present to offer good reason for the organization of an American Society of Geologists. This want is felt most by those engaged in the technical identification and description of fossils, and in the determination of the true values and relative position in the geological series of the rock masses appearing in the different parts of the country. For the purpose of mutual aid and cooperation in the furtherance of these ends, it was resolved by formal vote, as the sense of those present, that a distinct society of American geologists should be organized.

A committee was appointed to draft a constitution, but upon further consideration it was regarded as of great importance that all the geologists of the country (as far as possible) be consulted, and that permanent organization be deferred for more full and mature deliberation than could be taken during the present session of the Association. It was therefore proposed that a circular letter be prepared by the committee, conveying the sense of the geologists assembled, and that this be sent to all the geologists of America for their consideration and the time and place of the next meeting of the A.A.A.S. be designated for the final consideration and organization of such a society. The following are some wants which it is hoped may be attained by such an organization, and which are not provided for by any already existing society.

The want of greater uniformity in the methods of making and recording observations and in the usage of nomenclature; and a better understanding of each other's work over the vast territory of America.

The want of a common organ for the publication and discussion of geological matters, especially those relating to stratigraphy and paleontology.

The want of a central library in which shall be collected for reference and use a complete set of the publications needed by every working geologist, but many of which are at present out of print, very rare and almost impossible to be obtained or even consulted.

The desirability of the occasional meeting of American geologists for the purpose of coördinating and reducing to scientific system the great and rapidly accumulating mass of facts gathered by individuals or by state surveys in more or less restricted regions. The want of better facilities than at present exist of intercommunication among the numerous geologists in the country for their mutual aid and coöperation.

The geologists assembled at the meeting are of the opinion that those wants may be best supplied by the formation of a distinct society of

geologists, with a permanent organization, a central and
abiding place, and an organ for the publication of the work
bers. These views are respectfully submitted to our fellow
of America with the request that they give them careful
ion, and that all interested in the accomplishment of the
ere set forth may be present at the next meeting of the
t Montreal, and prepared to take action in the matter—the
n of such a society as will meet the necessities and be
grandeur of the work given to American geologists to ac-

cular letter finally prepared by N. H. Winchell and
y the committee reads as follows:

CIRCULAR LETTER.

ogists of America:
ting of the geologists in attendance at the Cincinnati session
he American Association for the Advancement of Science,
igned were appointed a committee to correspond with Amer-
gists, respecting the formation of a *American Geological*
e result of such correspondence to be reported at the next
the American Association for the Advancement of Sci-

to such instructions, it is deemed best to present sundry its work, membership and organization that its spirit necessarily, and properly, is not favorable to the development of any special work through its own agency.

4. The geologists as a body, have no way of expressing their views on important state, national or international measures, except through the medium of the American Association, at the meetings of which there is a perceptible and increasing lack of attendance and interest on the part of geologists, in consequence of which the actual views of the geologists of the country on such questions can not be obtained and expressed correctly.
5. There is a need of co-ordination of the results of state surveys, to the establishment of greater uniformity in nomenclature and classification.
6. There is a need of co-operation on the part of palæontologists, and of some system in describing and publishing new species.
7. There is no strictly geological magazine or journal in America.
8. There is no strictly geological society in America.
9. There are numerous such societies and journals in Europe, as well as journals and societies devoted exclusively to the branches of palæontology and mineralogy.

The committee desires also to disclaim any intention to trespass on the field and plans of the American Association for the Advancement of Science, or to criticise it in any way as to the discharge of its functions. Its tendency is to popularize science and to advance its acceptance by the world by diffusing scientific knowledge, and by announcing important discoveries, and as such its sphere of activity is one that no special scientific body can occupy, but which still will be aided by the existence of tributary organizations, such as that contemplated by this circular.

Persons to whom this circular is addressed are requested to communicate promptly their views and recommendations to any member of the committee, in order that a report may be presented at the Montreal meeting of the American Association, embodying such recommendations as may be warranted by the correspondence, and summarizing the same.

Signed: N. H. WINCHELL, State Geologist of Minnesota,
Minneapolis, Minn.
JOHN R. PROCTER, State Geologist of Kentucky,
Frankfort, Ky.
HENRY S. WILLIAMS, Professor of Palæontology,
Cornell University, Ithaca, N. Y.
JOHN COLLETT, State Geologist of Indiana,
Indianapolis, Indiana.
G. C. SWALLOW, Professor of Geology, etc.,
University of Missouri, Columbia, Mo.
WM. J. DAVIS, Palæontologist,
Assistant Geol. Sur. of Ky., Louisville, Ky.
S. A. MILLER, Palæontologist,
Cincinnati, Ohio.

H. S. Williams presented notes and suggestions at
l, in 1882, derived from the replies made to the circu-
out by the committee. Most of these are quoted be-
hose omitted are of persons who did not finally become
of the existing G.S.A.

iller, Cincinnati: Approves "if such a society can be formed
nwarranted contention."

worth Call, Des Moines, Ia.: "The project meets my hearty
." Urges that it should include only "working geologists."
ject is well devised." Very cordial in approval. A strictly
journal could be successfully sustained.

acfarlane, Tonawanda, Pa.: "Most heartily concurs with
rd" of the circular, and "sincerely hopes" the society may
d.

Upham, Minneapolis: Receives his hearty approval.
society can be abundantly supported" and "made an efficient
organization" and "will contribute to a more rapid and more
nsion of our knowledge in geology."

n and *W. G. Platt*, Philadelphia: Entirely agree with the
ee, and will cooperate in carrying out the scheme and the
ment of a geological magazine in any way that may be chosen.

Blake, New Haven, Ct.: Pledges his hearty cooperation in

G. K. Warren, Newport, R. I.: "I heartly endorse the movement."

J. E. Todd, Beloit, Wis.: "I say to you, as a member of that committee, *Amen.*"

A. Winchell, Ann Arbor, Mich.: "Circular letter was received with great satisfaction. The considerations presented seem to me pertinent and weighty. I promise it my full sympathy and support; and hope a large proportion of the representative geologists of America will return a hearty response to the project."

E. W. Claypole, New Bloomfield, Pa.: "I should be very glad to see such a society established in this country, and to do all I can to aid it. Nor do I think it impossible, though difficult to maintain such a society in an active and efficient condition." Endorses all the points in detail, and then considers whether such a society, if established, is likely to last and be successful. This depends mostly on the foundation and methods adopted. He does not think fortnightly nor monthly meetings could be sustained. England is so small that the geologists can attend such meetings. In the United States the distances are too great for members to meet often. If the meetings are to be held in connection with the A.A.A.S. there would be unpleasant rivalry. He concludes there should be *no meetings* but the *reliance shall be on publications alone* as the bond of union.

Robert Bell, Ottawa, Canada: Expresses hearty approval of the proposed Geological Society. Its desirability is so well set forth in the circular that it would be difficult to say more in favor of the plan. "I endorse every one of the reasons therein stated" etc., and "trust that my name will be put down as one of the original members" at the approaching meeting in Montreal.

Wm. M. Davis,Cambridge, Mass.: "I shall be very glad to aid the promotion of an American Geological Society in every way in my power—especially if it should undertake the publication of an authoritative journal in which besides original articles one could find abstracts of or references to everything of importance published in this country or in Europe connected with the subject. I think such a society, with its meetings and branch meetings (if necessary) and publications, would at once take good rank among the scientific societies in the country, and would have efficient support from geologists and paleontologists."

P. W. Schaeffer, Pottsville, Pa.: Heartly approves the suggestions of the circular, but queries whether there should not be head-quarters somewhere—perhaps in New York, with office, library and museum, with meetings sometimes there and sometimes at other points.

M. C. Read, Hudson, O.: "The formation of such a society would be of great advantage to American geology, especially if it leads to the establishment of a well-edited geological journal, as it would do much to secure a reliable and common nomenclature by American geologists."

S. E. Tillman, West Point, N. Y.: "Such a society, it seems to me, is very desirable and almost necessary; and I shall be most happy to aid in its establishment in every way in my power."

Billin, Ill.: "The geological society should stand on its
nd not start as a section of any other society. You can
as a supporter."
ich, Cincinnati, O.: "I heartily endorse the committee's

tee, Ann Arbor, Mich.: "In the circular letter the reasons
esirable to form a new society, in addition to those already
e stated quite cogently; and I am now more strongly in-
I have hitherto been, to favor the project."
hcock, Hanover, N. H.: "The proposal strikes me favor-
not necessary to be divorced from the parent association,
an for the chemical and entomological societies, which
old sessions in connection with those of the A. A. A. S.
be desirable to conflict with that. It might be practicable
metimes with the mining engineers. If the membership
e all geologists, it would be practicable to combine their
ecure certain objects not now attainable. We could organ-
ees to propose a scheme for classification of rocks or uni-
unless we accept the results of the International Congress.
atalogue the fossils, make a U. S. map, etc. Better than
l establish a magazine in which every one could be free to
opinions. We shall have to organize on a free, democratic
re should be no cliques to unite. The free voice of the

Society." "We shall probably, therefore, constitute a distinct body from that which you may form in the U. S., but shall be very glad to keep up friendly intercourse and coöperation."

Report of the Proceedings at Montreal, 1882 (official). At the Montreal meeting of the A. A. A. S., August. 1882, a number of American geologists convened to consider the question of organizing an American Geological Society; Prof. A. Winchell was chosen chairman and C. H. Hitchcock secretary. Several sessions were held, whose proceedings may be summed up in the following statements:

Prof. N. H. Winchell, chairman of the committee appointed in Cincinnati in 1881, to correspond with geologists upon the expediency of forming such a society, reported that ninety answers had been received in response to his circulars, all but two of which spoke favorably of the project. Prof. H. S. Williams, Secy., reported answers from thirty persons; and S. A. Miller reported answers from six persons, all favorable: making a total of one hundred and twenty-six opinions in favor of, and only two dissenting from the formation of the proposed society.

A committee consisting of Jed Hotchkiss, R. P. Whitfield, and C. H. Hitchcock was appointed to consider the situation, and report the most suitable action to be followed. This committee recommended as the first step to be taken, the establishment of a geological magazine. This report was accepted and adopted. The Cincinnati committee reported a constitution for the formation of a geological association, which was discussed and laid upon the table; and the committee desired to continue their labors and report at Minneapolis in 1883.

Last of all, a committee consisting of C. H. Hitchcock, J. S. Newbury, N. H. Winchell, H. S. Williams and G. H. Cook was designated to confer with Major J. W. Powell of Washington, with the view of ascertaining what encouragement could be afforded by him in the support of the proposed geological magazine.

On motion of James Hall it was voted to recommend to Section E (A. A. A. S), the appointment of a committee to confer with the director of the U. S. geological survey in regard to coöperation between the national and state surveys.

The persons present at these several meetings were Profs. A. Winchell, N. H. Winchell, E. T. Cox, H. S. Williams, W. H. Niles, E Orton, E. T. Nelson, Jed Hotchkiss, R. P. Whitfield, A. H. Worthen I. C. White, E. W. Claypole, G. H. Cook, J. W. Spencer, J. S. Newberry, James Hall, T. Sterry Hunt, H. F. Walling, E. D. Cope and C. H. Hitchcock.

C. H. Hitchcock, Secy.

The committee mentioned above conferred with major Powell in regard to the magazine. He expressed a desire for the success of the magazine, and a readiness to contribute to its welfare when established; but thought it would be prejudicial to its interests if he were identified with its inception.

C. H. Hitchcock, Secy.

PROPOSED CONSTITUTION.

ety shall be called "The American Geological Society." Its
l be the extension of the science of geology in America by
ng means:
publication of a geological magazine or journal.
publication of memoirs on any branch of the science in such
hereinafter provided.
maintenance of an organization for the discussion of gen-
ons of importance in cartography, nomenclature and stra-

assembling of the geologists of the country for mutual in-
nd comparison of their respective work.
on may become a member of this society by subscribing to
ution and paying the initiation fee of five dollars, and may
uch membership by the annual payment of the sum of three
ny member in arrears two years shall be stricken from the
ing he shall have been twice notified by the secretary of the
r an interval of six months.
Council. There shall be elected by printed ballot from
rs of the society after open nomination an *Executive Council*
twenty-five, whose duties shall be such as hereinafter pro-

the prosperity of the society and the promotion of geology in America.

Officers. The officers of the society shall be a president, who shall be elected annually by the society at large, and shall be the president of the executive council and a member thereof by virtue of this office; a secretary, who shall be elected by the council, who shall perform such duties as the council shall prescribe, and receive such compensation as the council shall determine; and a treasurer.

Minutes of the Minneapolis meeting. (Official.) At the Minneapolis meeting of the A. A. A. S., the adjourned session of the geologists assembled to consult about the geological society and magazine was held Aug. 21, 1883. The records of the Montreal meeting were read and approved. Prof. N. H. Winchell was elected chairman.

A letter was read from the Mineralogical and Geological Section of the Philadelphia Academy of Natural Sciences, addressed to the President of Section E favoring the formation of an American Society of Geologists "provided that such action shall be generally concurred in by American geologists,and that its permanency and a liberal publication of professional papers be insured by an ample endowment fund." [Signed] Chas. A. Ashburner, Secretary.

After much and varied discussion it was *Resolved* that a committee be appointed to confer with the Mineralogical and Geological Section of the Philadelphia Academy of Natural Sciences with reference to the formation of an American Society and the establishment of a geological magazine.

The president and secretary of section E at the Philadelphia meeting A.A.A. S. were designated as a part of this committee, the others being selected by Prof. N. H. Winchell, the chairman of this meeting. As finally constituted, this committee consisted of Profs. N. H. Winchell, E. A. Smith, C. A. White, C. H. Hitchcock, H. S. Williams.

The geologists present at the Minneapolis conference were N. H. Winchell, J. S. Newberry, T. S. Hunt, E. Orton, J. W. Spencer, E. T. Cox, J. W. Powell, W. Upham, J. P. Lesley, E. W. Claypole and C. H. Hitchcock. C. H. Hitchcock, Secretary.

The friends of the new movement became very much discouraged by the expression of unfavorable views at Minneapolis; and the report of these opinions seemed to have reached the members of the Philadelphia Academy, since they made no effort to consult with the members of the committee at the Philadelphia meeting of the A. A. A. S. in 1884. Four years later various causes led some of these opponents to change their minds, and the chairman and secretary of the moribund organization saw that nothing would be done by other parties, and so in virtue of their office they sent out a call to their confrères to meet at Cleveland, Ohio, in connec-

the 1888 session of the A. A. A. S. This final appea
o be efficacious as it led to the organization of the
al Society of America.
vhile, several of the geologists, unwilling to delay
e issuance of a geological magazine, boldly took the
and established THE AMERICAN GEOLOGIST, a monthly
f geology. The first number appeared January, 1888,
following gentlemen for editors and proprietors:
Calvin, Prof. E. W. Claypole, Dr. Persifor Fraser, Dr.
Hicks, E. O. Ulrich, Dr. A. Winchell and Prof. N.
hell. The call for the Cleveland meeting appeared
EOLOGIST for June, 1888, (which see).

s from answers to this circular:—

Potter, Washington University, St. Louis, Mo.: "I should
a geological society formed on an independent basis similar
the Geological Society of Great Britain, holding three or
ings a year and having the direction and control of a geolog-
terly magazine, in which high class papers on geological
hould appear, with reliable notes, references and reviews of
material. It does not seem to me that this is too much to
the present stage of geological knowledge and interest in this

nymous with section E. "I should prefer much to see an
eological Society to which none might be eligible except
have made contributions toward the advancement of
ology."

k, Albany, New York, favors the formation of a club or
tical with section E, and not a new distinct organization.
ggest a meeting in the early summer or in May, and to
object excursions to interesting localities."

tee, Ann Arbor, Mich. "I was not in favor of the indepen-
ation proposed at first, principally for the reason that it
y to antagonize the general society. To the present prop-
give a most cordial assent."

ner, State Geologist of Arkansas: "Hastens to say that
n of such an association seems to me most desirable, as is
hod suggested."

iams, Ithaca, N. Y.: "I would like to see a live American
Society; but I have serious doubts of the possibility of
ion E into such a society."

s, Lincoln Nebraska, is "in favor of the proposed organi-
American Geological Society."

tt, Indianapolis, Ind., is opposed to each of the proposi-
e to a connection with the A. A. A. S.

ce, of U. S. Geological Survey, doubts the expediency of
geological society in connection with the A. A. A. S. "I am
e organization of an American Geological Society as soon
el assured of its success. I will join, contribute freely
l work energetically for an American Geological Society,
s so constituted as to secure the support of two-thirds or
erican geologists; and though I should prefer that the
independent of the A.A.A.S., I will not make my support
pon that condition."

child, Secretary New York Academy of Sciences, approves
f the circular. "I doubt if a distinct geological society is
ch, all around, as section E of the A.A.A.S. But an in-
'American Geological Society," *being* section E has the
f both. It meets my ideas exactly."

razer of Philadelphia strongly opposes the proposition to
posed society coextensive with Section E.

fant of Montreal, would keep the two associations distinct.
management of the society will not fall into the hands of
r party.

th, Tuscaloosa, Ala., approved of the plan of the circular.

oadhead of Missouri, thinks that geology does not of
maintain its proper prominence in the A. A. A. S. and
ss to those who are trying to inaugurate a new association.

na of New Haven, Conn., thinks the proposed society
good thing and tend to promote good feeling among geol-
ll as good science. Only I would not have membership

lent upon membership in the national association, but instead
open the doors widely to all true geologists that care to come."
I. ***Davis*** **of Cambridge, Mass., asks if the proposed society would**
erfere with the winter meetings of the Society of American Nat-
s. Suggests that with membership as open as that of A. A. A.
society would not be an advanced institution. He would have
attention paid to technical geological business at the meetings
tion E, etc.

. ***Hitchcock,*** **Hanover, N. H., suggests (1) that members of Sec-**
, F and H of A. A. A. S. be eligible to fellowship in the new or-
tion; (2) officers of Section E to be ***ex officio*** **the managers of any**
neetings through the year; (3) sectional committee of Section E
ie President and Secretary to constitute the council for the man-
nt of the the society; (4) the council to call the extra meetings
make all the necessary arrangements; (5) excursions for the
e of acquiring familiarity with noted localities to be a specialty;
ecial publications to be issued whenever there are funds on hand
nt for that purpose; these to be issued in slips or forms and
uted to every member as soon as printed.

ketch of the meetings held later, leading to the establish-
of the present Society, will be found in volume 1 of the
in.

In accordance with the author's theory, now generally accepted, that the great oceanic depressions and continental plateaus became distinct features of the earth in the Archæan era and have since been permanent with only minor oscillations, we must refer the great volcanic range of the Hawaiian or Sandwich islands, as likewise other islands rising from abyssal oceanic depths, nearly all of which consist entirely of igneous rocks, to the eruption of molten portions of the primal earth crust, for no stratified deposits of considerable thickness could be formed so far from the borders of the continents. The lavas of the Hawaiian islands are augitic basalts, varying chiefly in the amount of chrysolite present. Molecular permeation of the magma in the volcanic conduits by water as superheated steam, producing vesiculation and in its escape throwing up jets of lava six to nine hundred feet high in the crater of Mount Loa, is attributed to infiltration of the water of rains and its slow absorption by the column of molten rock. This seems to be demonstrated by the more frequent occurences of eruptions in the rainy season, and by the greater volumes of steam and consequently higher lava jets in the summit crater than in Kilauea, 9,000 feet lower and twenty miles distant on the flank of Mount Loa. Furthermore, the independent and unsympathetic action of these vents upon the same mountain mass shows that the elastic vapor of water which uplifts their lava columns is accessory and of superficial origin, instead of being an original constituent of the magma at the great depth whence the conduits derive their supplies of lava and of volcanic heat.

This valuable treatise, and that of Capt. C. E. Dutton in the Fourth annual report of the U. S. Geological Survey, with the earlier notices reviewed by professor Dana, give to the Hawaiian islands the foremost place in the literature of vulcanology, a most important branch of geologic science still presenting many questions to be solved.

The Geographic Development of Northern New Jersey. By WILLIAM MORRIS DAVIS and J. WALTER WOOD, Jr. (From Proceedings of the Boston Society of Natural History, vol. xxiv, 1889, pp. 365-423; with 16 figures of maps and sections in the text.) This essay is based on field work by the authors as teacher and student at Harvard college, with the aids of the reports and admirable contoured maps published by the State Geological Survey. The investigation proved very instructive, and its methods and general conclusions will probably be found to have a wide application to other portions of the Atlantic slope when simularly accurate topographic maps of adjoining states and the eastern provinces of Canada shall be made.

The Appalachian revolution, culminating in Permian time, produced mountain ranges strongly folded and presumably of great hight for a certain period; but in the area of the Triassic belt their topography seems to have been reduced to a moderate relief before Triassic deposition began. During an ensuing epoch of mountain-building the great mass of sediments accumulated in the Triassic cycle suffered

nal tilting and faulting, with the result of a new mountainous
ohy of less elevation and much less structural distortion than
'ermian time. The Appalachian mountains are therefore not
garded as the residual relief of an elevation given once for all
ime of the great Permian folding. The original mountain
vere worn down low before and during Triassic time, after
n the Jurassic period, they were again uplifted and much
o a surface named by the authors the Schooley peneplain.
e southeastern portion of this area was moderately depressed
the sea and covered by Cretaceous sediments. The ridges of
ent time, showing remarkable evenness in their general hight
s of the old peneplain that have as yet withstood the erosion
ent on a third uplift, which as well as other oscillations of later
ms to have been of moderate amount and gentle inequality.
interesting studies of changes in the course of streams are
detail with numerous maps. The valleys in the Archæan
l portion of the peneplain are mainly coincident in position
se of an earlier geographic cycle, but in the Triassic area most
reams were superimposed upon the present rocks from Creta-
rata that formerly stretched across them, and in many instances
ear to have been much affected by adjustments required by
nudation of the soft Cretaceous formation and the uncovering

accompanied by volcanic outbursts along the course of the Sierra and Cascade ranges. Still later, during the Quaternary period, profound faulting has separated the high Sierra as a distinct range by the subsidence of the Great Basin region.

The author thus refers the upheaval of this highest mountain range of the United States and the immense lava flows of the Pacific slope to the same period during which ice was accumulated in vast thickness and weight on the northern half of the continent. The possible and indeed the probable causal connection of these great geologic developments has been pointed out by Prof. A. Winchell in the first volume of the AMERICAN GEOLOGIST. With the more extended exploration of the geology of the Sierra Nevada, now being prosecuted by Mr. Becker of the U. S. geological survey, we may hope for much fuller knowledge of its age and history; and at the same time Capt. Dutton's researches on the great volcanic areas stretching thence northward may be expected to afford means for close correlation with the drift formations and the continental ice-sheets.

The Fossil Butterflies of Florissant. By SAMUEL H. SCUDDER. Pages 433-474; plates LII and LIII; figures 20-22. (Accompanying the eighth annual report, U. S. geological survey.) Seven of the total seventeen known species of fossil butterflies have been found at Florissant, Colorado, as described in this memoir, in beds supposed to be of Oligocene age. Their general aspect is regarded as distinctly subtropical and American; but one species, belonging to the aberrant group Libytheinæ, is "specially curious, as it resembles least of all the American species of the sub-family, and most of all one that occurs in western Africa." From characters observed in the structure of the Florissant butterflies, Mr. Scudder infers that there was very rapid development when butterflies first appeared, or that they began to exist at a far earlier period than the Oligocene, in which, at Aix, the oldest fossil butterflies of Europe have also been obtained.

The Geology of the Island of Mount Desert, Maine. By NATHANIEL SOUTHGATE SHALER. Pages 987-1061; plates LXIV-LXXVI; figures 231-45. (Accompanying the eighth annual report, U. S. geological survey.) The examination of Mount Desert was undertaken for the purpose of determining to what extent this part of New England has been affected by changes of level since it was uncovered by the recession of the ice-sheet at the end of the glacial period. Mount Desert, the largest island of the rocky, fiord-indented coast of Maine, having an area of about a hundred square miles, was selected for this inquiry because it is the highest part of the whole eastern shore line of the United States. Green mountain, the culminating point, rises 1,527 feet above the sea, and the average elevation of the island is almost five hundred feet. Its cliffs of rock, mostly facing the south and east, and its long, smooth northwardly descending slopes of till, are well adapted for preserving evidences of former submergence of the land.

ssor Shaler believes that he finds one class of shore lines,
y, rock escarpments eroded by wave action, clearly traceable in
localities at successive hights, first, 90 to 100 feet above the
cond, about 160 to 195 feet; third, about 220 to 240 feet; fourth,
70 to 290 feet; fifth, about 300 feet; sixth, 380 to 430 feet; and
h, about 480 to 500 feet. At still greater heights precipitous
which Prof. Shaler thinks to have been worn by the sea, occur
erous places between 550 and 1000 feet above the sea. Finally,
more gently sloping mountain summits of the island, eroded
s of rock are found at the hights of 1,140 to 1,160 feet; 1,210 to
et; and, less distinctly, from 1,280 to 1,320 feet, at 1,460 to 1,480
d at about 1,510 feet, or only 17 feet below the top of the Green
in. The author therefore concludes that the Mount Desert re-
the time of the disappearance of the ice-sheet was depressed
ly not less than 1,500 feet, and certainly more than 1,200 feet,
its present level, to which he supposes that it has been elevated
ccession of uplifts, sometimes very sudden, with long interven-
ges of repose.

ems more probable, however, if not altogether sure, that the
rock benches and cliffs so fully observed and described
memoir have been produced by the ordinary process of subaë-
udation, in which the formation of horizontal benches, resem-
hose of shore lines, would result from the presence of the nearly
tal system of joint planes intersecting the granites of these

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THE THICKNESS OF THE DEVONIAN AND SILURIAN ROCKS OF WESTERN CENTRAL NEW YORK.

CHARLES S. PROSSER.

The Pioneer well of Findlay, Ohio, demonstrated in November, 1884, the existence of natural gas in commercial quantity in the Trenton limestone of northwestern Ohio. The discovery of a new geological horizon for oil and gas was followed by the drilling of test wells in other states, especially in those which were partly underlain by the Trenton limestone, and the attention of prospectors was early directed toward New York state as a promising field. In April, 1887, a test well was commenced in central New York, near Morrisville, Madison county.[1]

During the remainder of the year wells were drilled in western central New York at Ithaca, Seneca Falls, Clyde, Wolcott, and Fulton. In the Seneca Falls, Wolcott, and Fulton wells a small quantity of natural gas was obtained; but, not in sufficient amount for commercial purposes. The gas in the Seneca Falls well came from the upper part of the Medina sandstone and from the upper Trenton limestone in the Wolcott and Fulton wells.

Although the wells have been failures, in so far as obtaining natural gas for commercial purposes is concerned; yet, from a

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[1] A geological description and section of the Morrisville well are given in Proc. A. A. A. S. vol. xxxvi (1888), pp. 208, 209.

fic standpoint, they have furnished the geologist with
ant information. Previous to the drilling of these wells
not possible to give accurately the thickness of the De-
and Silurian rocks of central New York. The thick-
f the formations was estimated in various ways, princi-
y the following two: first, from sections of cliffs or
nd secondly from the supposed rate of dip per mile; but
been found that in nearly all cases these were underesti-
of the actual thickness of the formations. Furthermore,
stimates seem to have been regarded by many geologists
maximum estimate for the thickness of the rocks and
s reason they were inclined to regard them as an over-
te for the probable thickness of the formations.

communication recently presented by an able geolo-
a geological society it was stated that the Utica shale at
se, New York was one thousand feet below the surface.[2]
we remember that a well was drilled at Syracuse to the
of 1969 feet, that it stopped in the gray Medina and

ern boundary line of Wells township, Bradford county, Penn., not far from Wells station on the Tioga Division of the New York, Lake Erie and Western R. R. It is eighty rods south of the 77th mile stone of the state line between New York and Pennsylvania, and about eight miles southwest of Elmira, New York. Drilling was commenced November 15th, 1887 and finished April 17th, 1888. The well produced no oil; but a small amount of gas was obtained at a depth of 348 feet. At 371feet a little salt water was found and at about the same depth a vein of mineral water. The altitude of the mouth of the well is about 1600 feet A. T., according to Mr. Wm. Brown, to whom I am indebted for the samples of drillings. The well commenced in the upper part of the Chemung group and at a depth of about 930 feet there was a change from the greenish-gray, micaceous sandstone chips to those of greenish-blue or blue argillaceous shales, which are probably the upper part of the Portage group. The well was drilled to a depth of 2710 feet, without reaching the Genesee black shale, which indicates in this well a thickness of more than 1780 feet for the Portage. Or, since there is some doubt as to the line of separation between the Chemung and Portage, it shows that in southern New York, near the meridian of Elmira, the combined thickness of the Chemung and Portage groups is considerably more than 2700 feet.

Section of the Bird Creek Well.

Altitude, estimated, 1600′ A. T.

	Depth	Thickness	
Chemung.	400′	930′	First sample, greenish, non-calcerous sandstone.
	750′		Greenish-gray, micaceous sandstone, slightly calcareous.
	880′		Chips partly from light gray sandstone; but mostly from a slightly purplish sandstone, which is somewhat calcareous.
	930′		Greenish-blue, non-calcareous, argillaceous shale which is probably in the upper part of the Portage.
Portage.		1780′	The specimens from the remainder of the well are nearly all of greenish or bluish tint, are mostly from argillaceous or arenaceous shales which are usually non-calcareous. At 2700′ the chips are from a dark blue, finely arenaceous shale, which is slightly calcareous.
	2710′		The last sample from the bottom of the well, at 2701′ is a bluish to greenish-gray, fine grained, arenaceous rock, which is very slightly calcareous; also, there is blue argillaceous shale.

well drilled at Ithaca, Tompkins county, New York. Location in the valley, one-fourth of a mile south of Ithaca.

ickness.	Altitude 396′ A. T.
340′	Portage shales and sandstones.
100′	Genesee black shale.
30′	Tully limestone.
1142′	Hamilton shales and sandstones.
82′	Marcellus black shale.
78′	Corniferous limestone.
13′	Oriskany sandstone.
115′	Lower Helderberg limestones.
	Approximate top of the Salina group.
344′	Magnesian limestones, calcareous shales and some gypsum.
24′	1st rock salt stratum.
6′	Shale.
54′	2d rock salt.

Salina	2906′	6′	9th rock salt, 6′–8′.
	2912′	···· 279′	Some salt crystals.
	2922′	····	Green shale.
	2944′	····	Salt crystals, the last seen.
	3022′	····	Traces of mottled red and green shales.
			Green Shale.
	3046′	····	Mottled red and green shales. Most of the shale is green, but there is some red and green mottled.
	3130′	····	Last sample.
	3185′	—	Bottom of well according to the contractor, Mr. Rust.

The Ithaca well passed through from 1230′-1285′ of the Salina and only reached the first of the red and green mottled shales above the red shale.

For some additional information in reference to the Ithaca well see Trans. Am. Inst. Min. Eng., vol. xvi, pp. 941, 942. Also, N. Y. Ass. Doc. '89, No. 43, p. 22 and charts ii, iii and iv.

Section of well drilled at Seneca Falls, Seneca county, New York. Location in the Seneca River valley in the eastern part of the village.

			Altitude, approximately, 385′ A. T.
Salina group.		200′	Drab colored, impure limestones.
	200′	100′	Blue marls with an occasional red and green chip.
	300′	400′	Greenish-gray marls and drab colored limestones.
	700′	250′	Mostly bright red shale; but some mottled red and green shale.
	950′	400′	Dark blue limestone and shale in the upper part with greenish shales at the base.
			Niagara and Clinton groups.
	1350′	150′	Red shales and sandstones of the Medina group.
	1500′	—	Bottom of the well.

This well commenced in the upper part of the Salina group and was drilled to the depth of 1500′, the last 150′ being in the Medina group. See Trans. Am. Inst. Min. Eng. vol. xvi, pp. 949, 950.

Section of well drilled at Clyde, Wayne county, New York. Location in Clyde village.

			Altitude, approximately, 389′ A. T.
Salina.	152′	152′	Gray, green and blue marls with gypsum.
	308′	156′	Red marls.
		32′	Blue and green marls, probably Salina.

0′	Dark blue limestone, upper division of Niagara.
5′	Shaly limestone of Niagara.
	Approximate top of the Clinton group.
3′	Sample from 675′-690′ has a reddish tint, some of the chips are greenish and two are oölitic iron ore.
4′	Red shale of Medina.
3	Greenish, gray siliceous sandstone; the "Gray band."
15′	Red shales alternating with red sandstones and forming the Red Medina.
2′	Gray sandstone of Oswego (Vanuxem).
	Bottom of well.

s. Am. Inst. Min. Eng. vol. XVI, pp. 942,943.

well drilled at Wolcott, Wayne county, New York. Location in the ravine at Wolcott village.

Altitude, approximately, 317′ A. T.

Shaly layers of Niagara limestone above and Clinton

From these well sections has been compiled the following general section giving the thickness of the different geological formations, together with the total thickness of the series from the lowest Coal Measures down to the Archean. The thickness of the formations from the Barclay coal to the top of the Portage is estimated, while for the remainder of the series it has been obtained from the wells drilled at Bird Creek, Ithaca, Seneca Falls, Clyde, Wolcott and Ontario.

A general geological section of Western Central New York.

	1000′	Barclay lower coal. Pottsville conglomerate. Mauch Chunk red shale. Pocono gray sandstone. Catskill.	Estimated.
1000′			
	1200′	Chemung. Estimated.	
2200′			
	1780′	Upper Portage. Ithaca group. Lower Portage.	Record from Bird Creek well which does not reach the bottom of the Portage.
3980′			
	100′	Genesee shales.	
4080′			
	30′	Tully limestone.	
4110′			
	1142′	Hamilton.	
5252′			
	82′	Marcellus shales.	
5334′			
	78′	Corniferous limestone.	
5412′			
	13′	Oriskany sandstone.	
5425′			
	115′	Lower Helderberg limestones.	
5540′			
	1418′	Salina.	
6958′			
	335′	Niagara limestone and shales.	
7293′		?	
	83′	Clinton.	
7376′			
	942′	Red Medina; sandstones and shales.	
8318′			
	210′	Oswego sandstone.	Hudson Group
8528′			
	170′	Transition from Oswego sandstone to Hudson shales; gray sandstone and blue shales.	Hudson Group

0'	Hudson River group and Utica shale.
2'	Trenton limestone.
0'	? Calciferous limestone.
	Archean.

er to show the relation of the above section to our knowledge a general geological section, ranging the same series of formations, has been compiled from s. In the compilation of this section the maximum s of the formations, as near the line of section as possible been taken. The notes following the section give the y and reference to the work in which may be found the nt of the thickness of the various formations.

lized geological section along the meridian of Cayuga lake, the Barclay coal of Pennsylvania to the Archean of Ontario.

Barclay coal.	
From the Barclay lower coal to top of the	Pottsville conglomerate. Mauch Chunk shale

	(10) 110′	Lower Helderberg limestones.
4885′		
	(11) 1000′	Salina.
5885′		
	(12) 140′	Niagara limestone and shales.
6025′		
	(13) 80′	Clinton.
6105′		
	(14) 600′	Medina.
6705′		
	(15) 1000′	Hudson.
7705′		
	(16) 300′	Utica shale.
8005′		
	(17) 750′	Trenton.
8755′		
	(18) 80′	?Calciferous.
8835′		
		Archean.

Authority and reference for the thickness of the formations, as given in the preceding section.

1. Dr. Henry S. Williams. On the Fossil Faunas of the Upper Devonian along the meridian of 76° 30′ from Tompkins county, N. Y., to Bradford county, Pa. Bull. U. S. Geol. Surv., No. 3, p. 28.
2. *Idem. Loc. cit.* pp. 25, 26 and 29.
   See Trans. Am. Inst. Min. Eng., vol. XVI. p. 945.
   The Chemung in New York was estimated by Prof. Hall to have a thickness of 1500′ (Geol. of N. Y., Pt. IV, p. 260); this did not include 300′ of the Upper Chemung in Pennsylvania, but did include the Upper Portage of H. S. Williams and the Ithaca group of Vanuxem both of which Dr. Williams has referred to the Portage. Dr. Williams' estimate for this series was 1950′ (Trans. Am. Inst. Min. Eng., vol. XVI, p. 945).
3. Dr. Williams estimates the Portage, which is subdivided into the Upper Portage, Ithaca group and Lower Portage, as 1300′ in thickness (Bull. U. S. Geol. Surv., No. 3. p. 21). Vanuxem estimated the Ithaca group as about 400′ (Geol. of N. Y., Pt. III, p. 174) which is regarded by Dr. Williams as 450′ in thickness (Trans. Am. Inst. Min. Eng., vol. XVI, p. 945). Vanuxem said that "the wall of rock at Ithaca can not be less than about 400′ thick"; but this probably included some of the Lower (?)

nd Upper (?) Portage. Vanuxem called the Portage group, hich corresponds to the Lower Portage of Williams, 150′ ick (Geol. N. Y., Pt. III, p. 170), this is estimated by Dr. illiams to be 250′ in thickness (Trans. Am. Inst. Min. Eng., ol. XVI, p. 945).

xem said that "in the ravines east of Ludlowville [near e eastern shore of Cayuga lake], the slate [Genesee] ....cannot be less than from eighty to one hundred feet thickness" (Geol. N. Y., Pt. III, p. 169).

S. G. Williams says "On both sides of Cayuga lake the ickness of the undoubted Tully varies from twelve feet at ing's Ferry to a maximum of eighteen and one-half feet.... ....In the Owasco lake valley, the general thickness is mewhat greater than on Cayuga lake." One section in this tter valley is twenty-three feet thick (6th Ann. Rep't of the tate Geologist [N. Y.] for the year 1886, p. 19).

wrote "the thickness of this group [Hamilton] on the stern limit of the district [fourth geol. district, Cayuga lake gion] cannot be less than 1000 feet" (Geol. N. Y., Pt. IV, p. 94). Vanuxem gave the maximum thickness as 700′ (Geol. . Y., Pt., III, p. 151). While Dana states that "the greatest ickness—about 1,200 feet—is found east of the centre of the thickness, which is about 700′, in Wayne county" (Geol. Surv. of Canada. Rep't of Prog. from its Commencement to 1863, p. 346).

12. According to Hall the shale of Niagara group at Wolcott, Wayne county "is little less than 100 feet" and the limestone "is apparently not more than 30 or 40 feet thick in Wayne county" (Geol. N. Y., Pt. IV, p. 97).

13. The thickness of the Clinton group in Wayne county is somewhat less than 80′ (Hall: *Ibid.* p. 66).

14. Hall's report says "Its [the Medina] greatest width is on the Niagara river; but here a large portion of it is excavated on the north, leaving probably less than half its original extent within the state. From the width here exposed, the thickness actually measured, and the rate of dip to the southward, there is about three hundred and fifty feet of the rock between the mouth of Niagara river and the termination of the rock above Lewiston............This rock thins out entirely in an easterly direction in Oneida county." (*Ibid.* p. 43). At Rochester, N. Y., somewhat less than 600′ (Logan: Geol. Surv. of Canada. Rep't of Prog. from its Commencement to 1863, p. 310).

15. The Hudson group is from 800 to 1000 feet thick in central and northwestern New York (Hall: Geol. Surv. N. Y., Palæontology, vol. III, pt. I, text, p. 20, foot note). It is 770′ thick on the east side of the township of Collingwood, on Nottawasaga bay, at the head of Georgian bay, Ontario. (Logan: Geol. Surv. of Canada. Rep't of Prog. from its Commencement to 1863, p. 213).

16. The Utica shale is "250 feet in Montgomery county; 300 in Lewis county" (Dana: Man. of Geology, 3d Ed., p. 196). The Campbell well, three miles west of Utica, passed through 710′ of Utica shale and there are surface outcrops in the Mohawk Valley (?) of 600′ (Walcott: Proc. Am. Ass. Adv. Sci., vol. XXXVI, p. 212).

17. Vanuxem stated that "the greatest thickness of the Trenton limestone is in Lewis county............where it cannot be less than three hundred feet" (Geol. N. Y., Pt. III, p. 49). Emmons called it 400′; (Geol. N. Y., Pt. II, p. 116). In Ontario, Canada, north of Ontario, Wayne county, N. Y. it is 679′ (Logan: Geol. Surv. of Canada Rep't of Prog. from its Commencement to 1863, p. 186); and along the Trent river about 750′ (*Ibid.* p. 188).

    In the Campbell well, near Utica, about 430′; surface outcrops 290′ (Walcott: Proc. Am. Ass. Adv. Sci., vol. XXXVI, p. 212).

18. Logan wrote under the heading of the "Calciferous formation" that "On the west side of the ridge [Laurentian], follow-

ing the Potsdam where this is present and resting on the Laurentian series where it is wanting, there are generally met with thirty or forty feet of strata almost destitute of organic remains and about the same amount with a few fossils insufficient to determine the age of the strata with certainty." (Geol. Surv. of Canada. Rep't of Prog. from its Commencement to 1863, pp. 118, 119). Also, "to the westward of the Laurentian ridge of the Thousand Islands, there are about eighty feet of strata, the age of which is not very clear" (*Ibid.* p. 177 and see p. 182).

Calciferous and arenaceous strata in the Campbell well, near Utica, about 360′; surface outcrops 350′ (Walcott: Proc. Am. Ass. Adv. Sci. vol. xxxvi, p. 212).

ng the sum of these maximum estimates and we have a of rocks 8835′ in thickness between the lowest or Baral and the Archean.

n the State well at Syracuse, as reported by Dr. F. E. ardt, it is 1237′ from the top of the Niagara to the botthe red and brown Medina. (See Ann. Rep't Sup't aga Salt springs, for 1884. N. Y. Assembly Doc., 1885, pp. 15-17; and, Trans. Am. Inst. Min. Eng., vol. xvi, p. The thickness of the same series, and including the

This estimate located the top of the Trenton limestone at a depth of 2300′ and the bottom of the formation at a depth not exceeding 2800′. (See article on "Oil and Gas. Do they exist in this region?" Ithaca Daily Journal, April 19, 1887).

Taking the thickness of this series of rocks from the generalized section of maximum thickness and we have 4755′ as the depth of the top of the Trenton limestone at Ithaca, N. Y. The thickness of this series, as shown by continuous well sections in the preceding general section, is 5708′ or 953′ more than the supposed maximum thickness of this series. If the record of the state well at Syracuse be considered then the maximum estimate to the top of the Trenton limestone would be 5172′, or 536′ less than the probable thickness of these formations.

U. S. Geological Survey, June, 1890.

ARTESIAN WELLS IN NORTH AND SOUTH DAKOTA.

By Warren Upham, Somerville, Mass.

[Read before the Minnesota Academy of Natural Sciences, June 10, 1890.]

On the broad fertile plain called the Red river valley, which was the bed of the glacial Lake Agassiz, many artesian wells have been obtained within the thick drift sheet, deriving their supply of water from porous beds or veins of sand and gravel beneath, and frequently between, deposits of boulder-clay or till. The depths of these wells vary from 40 to about 250 feet, and the hight to which the water is capable of rising is often only a few feet and seldom more than 25 to 50 feet. Hundreds of these flowing wells, commonly one to two inches in diameter of pipe, are in use on farms, at grain elevators, and for the supply of towns, on both the Minnesota and North Dakota sides of the Red river. Some tracts of considerable area, however, fail to find artesian water, but even these generally encounter water-bearing layers at depths corresponding with those of the artesian wells, from which water rises nearly to the surface.

The narrow areas that may be sometimes occupied by the sand and gravel layers yielding artesian water, or the thin and in some places entirely deficient condition of these layers, is illustrated by the different depths at which a flow of water was first encountered by four wells in the village of Grandin, North Dakota. These

re on an area only about fifty rods in extent, and their
depths are 105 feet, 158 feet, 187 feet, and 248 feet.
he upper water-bearing beds here are narrow, like a stream
so that they were not found by the deeper wells, or, if
ist as sheets of great width as well as length, they are in
rts thinned out, allowing the impervious till above to rest
below. But in the direction from which the water supply
ved, these gravel and sand veins or beds must have a great
nd descend from levels higher than the central part of the
er valley, where the artesian wells are situated. At least
st be the case where the water is fresh or only very slightly
as at Grandin and in all the southern part of the valley as
thward as the vicinity of Crookston in Minnesota and
rd in North Dakota, and in a large district of Manitoba
g Winnipeg and the Mennonite reserve east of the Red

of Crookston and Blanchard to the international bound-
in the south edge of Manitoba, the water of these wells,
without exception, is distinctly saline and alkaline. It

wells are only 600 to 750 feet deep, and a few, the farthest southeast, are between 300 and 400 feet in depth. These wells are mostly five or six inches in diameter, and their strong pressure, commonly from 50 to 175 pounds per square inch at the surface, makes them valuable not only for fire-hydrants, but also to furnish power for manufacturing purposes. Several wells have been bored at Aberdeen, and three years ago fifteen wells were in use in Yankton. The pressure of the wells in Yankton is sufficient to raise the water 129 feet, and in numerous places along the middle portion of the James river valley, as Huron, Redfield, and Aberdeen, the pressure corresponds to a rise of more than 400 feet above the surface.

The sections of these deep wells in North Dakota and on the high land between the James and Missouri rivers in South Dakota include, beneath the drift, the Fort Pierre, Niobrara, and Fort Benton divisions of the Cretaceous series ; but along the lower part of the James river and on the Vermillion, erosion during the Tertiary era removed the upper portion of these beds, leaving only the Fort Benton shales or a part of that formation over the Dakota sandstone.

At Devil's Lake, where an artesian well was bored last year, about six feet above the depot, or 1,470 feet above the sea, the section was as follows :—

Section of Well at Devil's Lake.

Glacial drift, till as on the surface	25 feet
Dark shale, nearly alike through its whole thickness, including the Fort Pierre and Fort Benton formations, with no noticeable calcareous beds at the intermediate Niobrara horizon	1,403 feet
Gravel, of granitic pebbles up to a half inch in diameter, firmly cemented with nodular pyrite	3 feet
Dakota sandstone, or rather a bed of loose sand, very fine, white or light gray, the base of which was not reached	80 feet
Total	1,511 feet

From the sandstone, at the depth of 1,470 feet, artesian water came up with a rush, but sand soon filled the pipe so that the supply became small. It is from this level that the present flow comes, through narrow slits cut in the pipe. The boring was continued 40 feet deeper, but no such strong flow was obtained

In July, 1889, when the well was completed, it supplied barrels of water in 24 hours, or about 40 gallons per , the diameter of the pipe being 8 inches, reduced to 3½ in the lower portion. The stream flowing away was then with the exceedingly fine particles of sand brought up from ttom.

Jamestown well, bored in the winter of 1886-87, about feet below the depot or 1,400 feet above the sea, went h a similar section of about 1,400 feet of shales, with no tly different portion to indicate the place of the Niobrara ion. The same nearly uniform section has also been to a depth of 1,350 feet at Deloraine, in Manitoba, close est of the Turtle Mountain, as I am informed by Mr. J. rell of the Geological Survey of Canada. At that depth, was bored last year, there still lacked about 300 feet of ng the sea level, from which the Devil's Lake artesian ises.

the greater part of my notes of the artesian wells of South tween these points, its level is probably nearly constant; and borings at intervening towns, as New Rockford and Carrington, will doubtless find artesian water at or slightly below the sea level. Farther south, the top of the sandstone and its water supply are found throughout a large district of South Dakota and the south edge of North Dakota at a plane 250 to 450 feet above the sea.

Artesian Wells deriving water from the Dakota sandstone in North and South Dakota.

LOCALITY.	Dist. in miles on lat. & lon. from the S. E. corner of So. Dakota.		Depth in feet.	Pressure at surface in pounds per sq. inch....	Head above surface, in ft., computed from pres.	Altitudes in feet above the sea.		
	NORTH.	WEST.				Source of water in upper part of Dakota sandstone.	Surface, railroad at station	Head computed from pressure........
Devil's Lake...	390	119	1511			0	1464	
Jamestown....	305	110	1476	95	219	–76	1408	1619
Oakes.........	252	80	944			378	1322	
Ellendale......	243	101	1087	125	288	362	1449	1737
Britton........	228	72	1004			350	1354	
Columbia......	216	92	965	175	404	339	1304	1708
Andover.......	202	72	1070	90	208	406	1476	1684
Groton........	204	82	960	187*	432	344	1304	1736
Aberdeen......	206	101	908	175	404	392	1300	1704
Ipswich.......	204	127	1270	70	162	260	1530	1692
Mellette.......	186	101	900			400	1300	
Ashton........	174	101	915	50*	115	381	1296	1411
Doland........	167	81	950			405	1355	
Redfield.......	166	103	900	175	404	395	1295	1699
Faulkton......	176	132	1210			363	1573	
Hitchcock.....	148	97	950	175	404	389	1339	1743
Huron.........	130	88	863	175	404	424	1287	1691
Miller.........	140	126	1148	125	288	439	1587	1875
Highmore.....	141	148	1552	25	58	338	1890	1948
Harold........	141	163	1453			348	1801	
Woonsocket...	108	91	750	153	353	558	1308	1661
Letcher.......	97	85	600			700	1300	
Mitchell.......	84	79	600			701	1301	
Plankinton....	85	102	750			778	1528	
Kimball.......	87	126	1068			720	1788	
Vermillion.....	20	24	365	15	35	785	1150	1185
Meckling......	23	31	338			818	1156	
Yankton.......	27	46	610	56	129	586	1196	1325
Tyndall........	34	71	730			688	1418	
Ft. Randall....	38	106	600	45	104	660	1260†	1364

*The pressure reported at Ashton is 100 or 125 pounds less than would be expected in proportion with other localities; and at Groton it is somewhat more. The discrepancy of the latter, however, is no greater than may be due to superior permeability of the water-bearing stratum.

†Approximate altitude of high water of the Missouri river at Fort Randall.

ing still southward, from Woonsocket to the Missouri
e water-bearing stratum rises to altitudes from 558 feet to
above the sea, the highest levels being at Meckling and
on, the most southeastern localities of this list.
same southeastward ascent of the Dakota sandstone
to its outcrops on the southwest side of the Missouri in
county, Nebraska, whence its name is derived, opposite to
heast corner of South Dakota. There and at other exten-
crops in Western Iowa and Eastern Nebraska, having ap-
tely the same elevations as the surface at Vermillion and
, the water coursing through this sandstone finds outlet
s; and these avenues of discharge explain the gradual
n in the altitude of the head of water above the sea level,
eries of wells is followed from north to south and from
east. Somewhat uniform altitudes of 1,619 to 1,743 feet
rded as the hights to which water would rise in pipes for
wells, where pressure is reported, from Jamestown to
and Woonsocket, excepting those west of Huron, which

All the eastern outcrops of the Dakota sandstone are lower than the upper portions of the James river basin and the wells farther west at Highmore and Harold. These outcrops therefore cannot be the sources from which the sandstone receives its artesian water, but, as we have seen, they are the avenues of its natural outflow. We must look instead to the western outcrops of this formation, where it skirts the Black Hills and exposes its upturned edges along the base of the Rocky Mountain ranges, for the areas upon which water is carried downward into the sandstone. Thence we know this stratum to be continuous beneath the plains to the James river valley, for there are no nearer nor other inlets from which the copious supply of the artesian wells can come. At a plane of similar or greater depth an artesian reservoir exists beneath much, if not all, of the country westward to the mountains. The gradients of the altitudes to which the water of wells is capable of rising along east to west lines in South Dakota, as at Huron, Miller, and Highmore, are approximately the same as the average westward ascent of the country, demonstrating this western origin of the water supply, and indicating that such wells may be obtained upon an extensive region of the arid plains.

How far then can this artesian water be utilized for irrigation? Will it be practicable to store the water in reservoirs for use in the season of growing crops, and especially during severe droughts like that which so reduced, or in some portions entirely cut off, the crops in North and South Dakota last year? To this inquiry we may reply by computing the amount of water needed for irrigating a given space, as a quarter-section of 160 acres, the usual area of a homestead. Allowing a depth of twelve inches of water for this use during the growing season, the year's supply of water from a well flowing 100 gallons per minute is required, without allowance being made for leakage or evaporation from the reservoir. The Devil's Lake well would, therefore, irrigate only 64 acres, and the Jamestown well, flowing 375 gallons per minute will water less than a section one mile square. But each of these wells cost about $7,000, to which must be added the cost of the construction of reservoirs and irrigating ditches, placing the expense of such water supply far beyond its prospective value for ordinary agriculture.

nportant objection, however, against the use of this water
ation seems to lie in its dissolved alkaline and saline mat-
ch must be left in the soil. After continued use in irriga-
ng many years, the residuum from this water would quite
prove injurious to crops, so that the land would become
s. Such results have attended irrigation with only very
alkaline water on the alluvial plains of the arid north-
provinces of India. The proportion of sulphate of soda
ns flowing down from the Himalayan range and in canals
ater from them varies from 9 to 43 parts in a million,
proportion of common salt is from 0.23 to 15 parts; yet
e dry climate of northwestern India the natural evapora-
so nearly pure water, and its use in irrigation, have caused
e tracts of land formerly productive to become barren.*

nalysis of the water of the Jamestown well, which doubt-
ely resembles that of all the wells obtaining their supply
Dakota sandstone, is given by Prof. James A. Dodge,
ity of Minnesota, as follows :—

tion hundreds of miles through the sandstone. They are the same in kind and similar in amount with the mineral matter of Devil's lake, concentrated by evaporation without outlet from the water of inflowing streams and springs, which bring very small amounts of these salts dissolved from the drift and Cretaceous shale of the adjoining country.

Much shale, gravel and detritus, rich in sulphates, are present in the glacial drift over nearly the entire Red river basin, and the percolating rain-water, found by the fresh artesian wells in the drift of the southern and northern ends of the Red river valley, has acquired minute quantities of alkaline and saline matter. But where its proportion is large, as in the brackish water of the wells from Crookston and Blanchard northward to the edge of Manitoba, it seems impossible that so remarkable difference can be due to diversity in the material of the drift, or to longer time and better opportunity afforded to the water for such impregnation while percolating through porous beds or veins in the drift. The saline and alkaline artesian waters of the drift gravel and sand along this central portion of the Red river valley therefore appear to be received mainly from the same Dakota sandstone which supplies the deep wells of the James river valley.

Several wells in the vicinity of Blanchard and Mayville, 375 to 404 feet in depth, pass through the drift and enter a very fine white sandstone, probably the Dakota formation, from which they obtain flows of brackish water. About a dozen miles east of Blanchard the drift was found to have a total thickness of 310 feet, below which a boring went 107 feet into exceedingly fine white sandstone, finding, however, no artesian water, apparently because of the very close texture of the rock. The top of the sandstone in these wells is 650 to 575 feet above the sea. If it is the Dakota sandstone, as seems probable, it has an ascent of about 600 feet in 75 miles east from the meridian of Devil's Lake and Jamestown, rising in its approach toward the Silurian, Cambrian, and Archæan areas of Minnesota and Manitoba. It may be thus the bed-rock, on which the drift is deposited, beneath extensive tracts in the middle part and on the western border of the Red river valley, discharging there its alkaline and saline artesian water into the permeable beds of gravel and sand in the drift sheet, whence it rises in the brackish wells of that district.

s the classes or groups of artesian wells thus far con-
here remain to be mentioned numerous shallow flowing
m 20 to 168 feet deep, in the drift of the Vermillion
n in South Dakota, reported by Prof. G. E. Culver, and
artesian wells in North Dakota at Tower City and Graf-
e wells in the vicinity of the Vermillion river are on an
rked by grand contrasts of elevation, though toward the
northeast the surface gradually rises in the Coteau des
They seem to be comparable with the plentiful flowing
ountains along the Maple river in Blue Earth and Fari-
nties, Minnesota.

wer City well, fifty miles east of Jamestown, is four feet
n the depot, being 1,168 feet above the sea. Its depth
t, through drift, 163 feet; Cretaceous shales, with occa-
ls of sandstone, 502 feet; and quicksand, into which the
vanced only 5 feet. Salty and alkaline water outflows
s per minute, and is capable of rising 33 feet above the
The scanty flow and low head of this well suggest that

formation of that series, 398 feet, yielding a feeble flow of very salt water from its upper part; (5) sandstone, perhaps a trace of the Dresbach sandstone of southeastern Minnesota, 5 feet, yielding a small flow of brine, which was analyzed by Prof. Henry Montgomery of the University of North Dakota, and pronounced more saline than sea water; and (6) granite, as determined by Prof. N. S. Shaler from specimens of the borings, 12 feet. The water used from this well is taken from the top of the Jordan sandstone, at the depth of 438 feet. The diameter of the pipe is six inches, and the flow, according to three measurements in 1886 and 1887, during the first year after the completion of the well, was 800 gallons per minute. The reference of this section to the Cambrian series seems to be well determined by correlation with other wells penetrating Cambrian strata in this valley at Humboldt, Minnesota, and Rosenfeld, Manitoba, respectively about thirty-five and fifty-five miles farther north. At Rosenfeld, however, according to my interpretation of the section, the Cambrian series is overlain by 352 feet of Lower Silurian strata, which are there the bed-rocks first encountered below the drift. Not far west of Rosenfeld and south of Grafton, the Dakota sandstone, forming the base of the great Cretaceous series which is penetrated by the wells at Deloraine, Devil's Lake, and Jamestown, probably abuts, with horizontal or only slightly inclined stratification, upon the similarly almost horizontally bedded Silurian and Cambrian rocks.

THE LOWER AND MIDDLE TACONIC OF EUROPE AND NORTH AMERICA.

By JULES MARCOU, Cambridge.

III.

ORDER OF SUCCESSION OF THE LOWER AND MIDDLE TACONIC FAUNAS, AND THEIR COMPARISON IN EUROPE AND NORTH AMERICA. —I. The older strata containing fossil remains are round St. Johns, Newfoundland. Until now, no trilobite has been found and no one of the other old forms known in the primordial fauna has been discovered there; the only fossil remain being an *Aspidella*, the oldest animal yet found in the world. The same strata are very likely in the Grand Cañon of the Colorado and in the Wasatch mountains of Utah; but until now we possess no palæontological proof. In Europe the *Newfoundlandian*, in French *Terreneuvien*, has not yet been signalized, even hypothetic-

Ve do not know of it so far, in Esthonia, nor in Scandi-
It may however be found there and in the British Isles,
mia and the southern part of Europe.

he next formation or *Schmidtia* zone is in Russia, Scandi-
he British Isles, and Bohemia. But outside of Esthonia
y on stratigraphical principles; round Revel only a fauna
discovered below the *Holmia* zone. So far we have nine
one trilobite—*Schmidtia mickwitzi*, the oldest in the world.
ns of very low and imperfect brachiopoda, a problematic
lled *Volborthella*, one Cystidæ and one *Medusites*. Cer-
very meagre representative fauna of all the forms of
animals which developed rapidly during the Middle Taconic

nly formation, in the Nevado-Canadian sea, which may
o the Esthonian or *Schmidtia* zone, is the Chuar formation
rand Cañon of Colorado, where three doubtful forms of
animals have been signalized. It may be that those few
ly preserved forms belong to a higher horizon, and that

Its separation from the *Paradoxides* zone, made by the Scandinavian geologists, is well justified and is a good move in the classification. The names proposed are in harmony with the whole scheme of nomenclature used in geology, and recall the country where it was first discovered and the most characteristic form of fossil contained in it: Scandinavian formation, or *Holmia* zone.

Lately an unfortunate confusion has arisen from a too hasty identification of generic forms, which are widely separated; and the consequent parallelism and equivalency of the great Georgian formation or *Elliptocephalus* (*Olenellus*) zone with the Scandinavian formation, or *Holmia* (*Paradoxides-Olenellus*) zone is an error to be regretted, on account of the great publicity it has received, too hastily, at the International Congress of Geologists, London, in 1888.

Until now the Scandinavian formation has been found only at four localities in Scandinavia, two being near one another north of Christiania; and another one found in Lapland has not yet been described. In England, its existence has been signalized by professor Lapworth at one single locality, and in Newfoundland, since 1868, it is known in Conception bay. In all six outcrops of the Scandinavian formation fauna are actually known.

The number of fossils found, described or simply signalized is about forty species with a certain number of varieties. Thirteen species are actually known in Scandinavia; very likely three or four more species will soon be added by Dr. Holm when he has

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searches, and he had no idea that there were two distinct systems inclosed in it. The confusion he made was cleared out first by Dr. Emmons in America, and afterward by Barrande in Europe; both of whom showed that below the fossiliferous strata found and described by Sedgwick, there was a great system of strata containing an older and special fauna, entirely unknown to Sedgwick and Murchison.

The Cambrian of Sedgwick, by all rules of priority and classification according to great faunæ, is confined to the second fauna, which, *mirabile dictu*, is called, by the actual geologists of the British empire, *Ordovician* by the Cambridge school, and *Lower Silurian* by the school of the Geological survey of England. The name *Champlain* given by Dr. Emmons, as far back as 1842 to the second fauna system, antedates Ordovician by thirty-seven years; and so long as the English geologists maintain their present classification against all right of priority, it is important for American geologists to use their national classification of Taconic system and Champlain system, for the strata containing the primordial and the second faunas, instead of Cambrian system for the primordial fauna and of Ordovician system for the second fauna, two names entirely unadapted to fulfill the rules used in geology for classification and nomenclature. (See for all the exact dates, my paper: "On the use of the name Taconic" in *Proceed. Boston Soc. Nat. Hist.*, vol. XXIII, p. 343, March, 1887).

d his materials collected in southern Lapland. We have
r species in England, thus making about twenty species for
ndinavian formation of Europe. In Newfoundland we
o about twenty species. Total 40 species.

ilobites are the most conspicuous forms in that fauna,
them, like the genus *Holmia* attaining the dimensions of
ate sized *Paradoxides.* The relations of the genus *Hol-*
aradoxides and *Elliptocephalus* (*Olenellus*) has been very
ted out and characterized by Dr. Holm. Brachiopods of
forms and organization are found with a certain number
pods.

e whole, the fauna of the Scandinavian formation does
l much evidence in favor of the theorists on the origin
ent of species. So far the results are negative, as has
intained with great force by the greatest of all the
paleontologists, M. Joachim Barrande.

he great *Paradoxides* zone or *Bohemian* formation ap-
more numerous patches and more widely scattered than
preceding formations. As a consequence its fauna is

Table I.—Europe (Eastern Part of the Acadio-Russian Sea.)

		Scandinavia and Esthonia.	British Islands.	Bohemia.	France.	Sardinia.	Spain.
MIDDLE TACONIC.	IV. Bohemian formation or Paradoxides zone.	Paradoxides slates. 6. Agn. lævigatus. 5. Parad. forchhameri 4. Par. oelandicus. 3. Par. davidis. 2. Par. tessini.	Paradoxides zones of the Menevian and Harlech groups.	Paradoxides zone or primordial fauna of Ginetz and Skrey.	Paradoxides of Ferrals-les-Montagnes (Hérault.)	Paradoxides of the vicinity of Iglesias.	Paradoxides of Leon, Asturias and Saragozza.
	III. Scandinavian formation or Holmia zone.	Holmia slates—1 Parad? or Olenellus? or Holmia kjerulfi.	Beds of Caer-Caradoc—Olenellus? or Holmia callawei.	Unknown.	Unknown.	Unknown.	Unknown.
LOWER TACONIC.	II. Esthonian formation or Schmidtia zone.	Fucoid sandstone. Blue marl with Olen? or Schmidtia mickwitzi. Sandstone.	Longmynd group in part; but fuana unknown.	Division A. and B., or Azoic stage, representing stratigraphically the Lower Taconic.	Unknown.	Unknown.	Unknown.
	I. Newfoundlandian formation.	Unknown.	Unknown.				

the Acadio-Russian Sea.)

New Brunswick.	Massachusetts.
Paradoxides zone or Division 1, of Mr. Matthew.	The lower part only of the Paradoxides zone at Braintree, Boston.
The Division O. of Matthew, is stratigraphically the Holmia zone.	Unknown.
Unknown.	Unknown.

Table III.—America (Nevado-Canadian Sea.)

		Vermont, New York, Canada, and Strait of Belle Isle.	Grand Canon of the Colorado.	Nevada and Utah.	British Columbia.
MIDDLE TACONIC.	IV. Georgia formation or Elliptocephalus (Olenellus) zone.	Elliptocephalus (Olen.) zone of Bald mountain, Georgia, Bic harbor and Belle Isle. Divisions c. and a. of Emmons.	Unknown.	Elliptocephalus (Olen.) zone at Eureka, Highland, Pioche, Wasatch, Ophir.	Elliptocephalus (Olen.) zone at Mount Stephens, near the Canadian Pacific railway.
	III. St. Albans formation.	Want a careful study. Division e. granular quartz of Emmons with Holmia?		Prospect Mountain quartzite.	
LOWER TACONIC.	II. and I. Chuar formation of the Grand Canon of Colorado.	Conglomerate and Talcose slates of Vermont?	At one third of the thickness of the formation in descending order, there is a discinoid shell, an obscure Hyolites and a fragment which may belong to a trilobite?	10,000 feet of strata exist below the Elliptocephalus zone in the Wasatch mountains, and belong mainly to the Lower Taconic.	10,000 feet of strata exist below the Elliptocephalus zone of Castle mountain which belong mainly to the Lower Taconic.

IV.—Synchronism of the formations in the Acadio-Russian and Nevado-Canadian Seas.

o-Russian Areas.	Canadian Area.	Nevadian Area.
. Bohemian forma- on or Paradoxides zone.	IV. Georgia formation. The lower part wants more study before we can know if it is the exact homotaxical fauna of the whole Paradoxides zone.	IV. Georgia formation. In British Columbia it seems more developed and represents there the whole Paradoxides zone.
I. Scandinavian mation or Holmia zone.	III. and II. The St. Albans and Granular Quartz formations want to be explored and studied carefully before any correlation and synchronism is attempted with the Holmia and Schmidtia zones.	III. Unknown paleontologically.
Esthonian forma- ion or Schmidtia zone.		II. Grand Canon of the Colorado; small fauna referred with doubt to the Esthonian formation.
		I. Unknown paleon-

kin for the Jura and the Trias periods. Mr. Edward Hull, the learned director of the Geological Survey of Ireland, has made researches in the same field, but on a more limited area. Mr. Hull has given a series of very interesting paleo-geological and geographical maps of the British Islands and the adjoining parts of the continent of Europe. And finally, the important memoir of Director A. Karpinski of the Geological Survey of Russia, on the physical geography in geological times of Russia in Europe, should be mentioned. I shall say only a few words in regard to the theory put forward many years ago, of the permanency of the continents and oceans, which is still advocated by a few geologists,†—generally only theroists—and which is strongly supported by zoologists. Partisans or adversaries of the evolution of species want the permanence of the continents and oceans, to sustain their views, however conflicting they may be, and they do not hesitate to maintain as a creed that with slight changes only the oceans and the *terra firma* have always presented the same geographical distribution as now. It is simply a wrong generalization from the facts, which every practical geologist readily accepts: that is to say, that some part of the *terra firma* has al-

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†Professor James Geikie in a paper entitled: "The evolution of climate," with maps, just issued as a reprint from the *Scottish Geographical Magazine for February, 1890*, says at p. 21: "But, although the boundaries of the land masses shown upon the maps referred to are thus confessedly provisional, the maps nevertheless bring out the main fact of a gradual growth and consolidation of the land-areas—a passage from insular to continental conditions. I need hardly say this is no novel idea. It was clearly set forth by professor Dana upwards of forty years ago (*Silliman's Journal*, 1846, p. 352; 1847, pp. 176, 381), and it received some years later further illustration from professor Guyot, who insisted upon the *insular* character of the climate during paleozoic times (*The Earth and Man, 1850*)."

The idea of a gradual growth of the land-areas—a passage from insular to continental conditions did not originate with professor Dana or professor Guyot, who only applied it many years after its publication, in France, by Elie de Beaumont, who is the true originator of the idea. Elie de Beaumont was in the habit of showing such maps and used them, in his lectures on practical geology, at both the College de France and the School of Mines in Paris, as far back as 1836. Professor Beudant, with the permission of Elie de Beaumont, has published three of those maps for the Jurassic, Cretaceous and Tertiary seas in his *Cours Elementaire de Geologie* pp. 237, 241, and 243, 1841: and professor Carl Vogt in his *Lehrbuch de Geologie und Petrefactenkunde*, 1845, based entirely on the lectures of Elie de Beaumont during 1844-46, as he expressly says in his introduction, gives at the end of his manual, four large maps of the Carboniferous, Jurassic, Cretaceous and Tertiary seas. So the "novel idea" is due to Elie de Beaumont: and its publication was made first by Beudant in 1841, and afterward by Carl Vogt in 1845, several years before Dana's and Guyot's publications.

en dry land and was never covered by salt water and con-
ly by sedimentary marine deposits. The number of such
s very limited, and more so than appears from a first
at the "Geological Map of the World"; for dislocations
enormous scale have brought to light great masses of
ine rocks which were concealed under strata during cer-
iods of the earth's history; it is not safe, for instance, to
e from the existence of the great masses of crystalline
f the Alps, or Himalaya, or Rocky mountains, that those
were always out of the seas and formed dry lands. Struct-
d orographic geology must be always consulted and ap-
efore reaching conclusions. And any one who has studied
y any part of the earth, where crystalline rocks exist,
esitate more than once, before saying such part of the
ine or primitive rocks has been and remained out of the
f sea water, and has never been covered by sediments of
t, except from the aerial decomposition of the crystalline
That such areas exist, it is certain, among the great
of primitive rocks which cover great surfaces; such, for
as the great Scandinavian peninsula, and its adjunct

ordination of facts scattered over one-half the northern hemisphere and which need some sort of bond to consolidate what has already been acquired, by the isolated efforts of fifty or more practical geologists from St. Petersburg to Prague, Madrid, St. David, St. Johns, Cambridge, Williamstown and Eureka city.

The Acadio-Russian sea, was bordered on the north by a Taconic continent running from the vicinity of Revel (Esthonia), to Lapland, Scotland, Ireland, Labrador and the northwest territory of the Canada Dominion. On the east, was an extensive peninsula, starting somewhere near St. Petersburg and extending between Scania and the Basin of Bohemia, as far west as Cornwall and French Brittany and probably a little farther west. Then a sort of Mediterranean area covered by the Acadio-Russian sea, connected Bohemia, France, the Iberian peninsula and the island of Sardinia. South of it, the Taconic continent was formed, very likely, by the whole region of the Barbary states, the Great Sahara desert and the Guinea coast. There seems to have been a sea between Africa and South America.

A narrow and very extended isthmus, connected the North Taconic continent with the South Taconic continent, from Labrador, east of the Straits of Belle Isle, descending to Nova Scotia, the White mountains of New England, Boston, eastern Virginia, Georgia, and expanding under the form of a great continent, which occupied the whole region of the West Indies, Central America, Venezuela, Guiana, Columbia, southern Mexico and extending some distance into the actual tropical Pacific ocean.

West of the great isthmus just spoken of, and inclosed on three sides by dry lands, we have the Nevado-Canadian sea, with its opening west and its extension into the Pacific ocean of that time.

All the outcrops of Lower and Middle Taconia with their special faunas, exist in a single band, which can be called the North Neutral Homozoic band of the Taconic period. In it we have in the two seas, three provinces of marine animals for each sea; which seems very distinct and appropriate. Beginning at the east side, we have first (alpha) the Scania-Wales province, comprising all the part of the Acadio-Russian sea, which extends between Russia and England; then (beta) the Asterio-Bohemia province, comprising Bohemia, France, Spain and Sardinia; and finally (delta)

'ewfoundland-Massachusetts province, comprising south-
1 Newfoundland, New Brunswick and Braintree. Each one
se provinces is characterized by special fossils, some pass-
om one province to another; but so far the common species
ry few.

he Nevado-Canadian sea, we have also three different prov-
f marine animals. The (epsilon) Belle Isle strait—Bald moun-
rovince, comprising the straits of Belle Isle, Canada bay,
ole Gulf of St. Lawrence region, Quebec, Vermont, eastern
'ork, and farther south. The primitive and original area of
conic system with the Taconic range of mountains and the
here Dr. Emmons discovered the primordial fauna, are en-
in that province. The (gamma) Eureka-Utah province, com-
the state of Nevada, the territory of Utah, and the Grand
of the Colorado. Finally the (pi) Castle Mountain prov-
f British Columbia, comprises all the areas north of the
ling province. All these three provinces of the Nevado-
lian sea are connected by similar forms of fossils and also
'ew common species.

il now we have no indications of the Taconic faunas exist and will be sufficient to allow geologists to give then, a first well based generalization on what was our globe zoologically, as well as physically, during those far remote Taconic times.

Cambridge, Mass., March, 1890.

ON THE CHEYENNE SANDSTONE AND THE NEOCOMIAN SHALES OF KANSAS.

By F. W. Cragin, Topeka, Kansas.

[This article was originally prepared as a contribution to the November (1889) meeting of the Kansas Academy of Science, but was afterwards withheld from the Academy's *Transactions* for the purpose of incorporating additional data, and was published in the *Bulletin* of the Washburn College Laboratory, No. 11 (dated March, 1890, but not issued till April 3).

It is believed to be of sufficient interest to entitle it to a wider reading than it can have through the medium of a local *Bulletin*, and it is here reproduced with a few slight changes, but essentially as it was published in the *Bulletin*.]

Resting unconformably upon the fine-grained brick-red deposits of the Triassic of southern Kansas, in parts of Barber, Pratt, Kiowa, and Comanche counties, on the upper drainage of the Medicine Lodge river and on Mule creek, may be seen a stratum of friable, false-bedded, littoral sandstone, attaining locally a thickness of forty feet. It is ordinarily rather coarse-grained, sometimes gravelly; in a few localities exceedingly fine. Its slight but variable coherency imparts to it a rugged relief. Indeed, the outcrop of this rock offers more variety of form and color than that of any other formation in southern Kansas, though its features are on a smaller scale than that seen in the Gypsum Hill Permian of Barber county.

Two or three "Hell's Half Acres," mere skeletons of the original stratum; the "Natural Corral," in the southeast corner of Kiowa county; the "Natural Well," in Comanche county, near Mule creek; Osage Rock, a prominent point of rocks opposite the village of Belvidere; and numerous named and unnamed chimney-rocks, castles, forts, and gulches—some of them gaily decorated with spots and stripes of purple, crimson, scarlet, and brown, but of prevailing yellow, gray, and whitish shades—are characteristic features in the relief of its outcrop.

The dip is to the southeast.

While this sandstone seems to be closely related to the Potomac and Tuscaloosa divisions of the Atlantic states, to the Trinity division of Texas and Arkansas, and to the Atlantosaurus beds of Wyoming and Colorado, it would be premature to assert positively,

s time, the precise identity of any two of these. Incom-
geographic and stratigraphic data suggest a probability that
ove described sandstone represents a portion of the Trinity
on; but reference of it to the Trinity division in any way,
the Indian Territory interval has been explored, is of course
y a supposition, however probable.

fauna of the Trinity division, according to Prof. Hill, is
ck-Wealden in its affinities, but according to Prof. Marcou,
eferable to the upper Jurassic. That of the sandstone under
leration is wholly unknown. The one genus known to be-
o the flora of the latter, ranges from the Purbeck to the up-
eocomian, but the species is most like those of the Purbeck.
default of precise knowledge as to the stratigraphic and
ntologic equivalency of this sandstone, it will be expedient
ow it, for the present, by a local name. I designate it,
ore, as the Cheyenne sandstone. This name was suggested
Bul. Washburn Coll. Lab. Nat. Hist., No. 11, p. 70) in
on to the prominent point of rocks above mentioned as
ge Rock," which has been called by some, "the Cheyenne

Cycadoidea munita. The type-specimen indicates a stump a foot in diameter and of about the same or a little greater hight, and of broadly ovate outline in side-view. The false-bark, which seems to have been more or less readily separable from the wood, had a thickness of 3.25 to 3.75 inches in the region of greatest horizontal diameter of the stump, diminishing to 2.25 inches or less in the upper portion. The rhomboidal markings on the exterior of the false-bark measured 1 to 1.5 inches by .6 to .8 inch (for the most part about 1.25 inches for the horizontal dimension). The species is thus intermediate in its characters between *C. megalophylla* and *C. microphylla.* For an account of the character of the inner portion of the leaf-stalk, and for other details, the above-cited reference may be consulted.

The Maryland cycad announced by Mr. T. P. Tyson in 1860[‡] was, as I am informed, taken from the formation now known as the Potomac Division. A photograph, for the use of which I am indebted to Mr. Jules Marcou, representing this cycad with an extended two-foot rule beside it, and thus providing for accurate comparison with the Kansas specimen, indicates[§] the probable specific identity of the Potomac cycad with the latter.

Occurring abundantly in the Cheyenne sandstone are silicified logs belonging to trees of the coniferous sort, but of genera as yet undetermined. They are presumably allied to those which are associated with *Cycadoidea* in the Purbeck and Neocomian of England. One of these logs was traced by the writer from the loose sand of a ravine into the solid sandstone and for a length of forty-five feet, which included neither stump nor tree-top, the smaller end having a thickness of thirteen inches. It is to this sandstone that the ordinary petrified logs seen in door-yards, and in use sometimes as hitching-posts in the Sun City and Belvidere district, belong.

Seams of lignite and fragments of soft, charcoal-like, bituminized wood occur in the Cheyenne sandstone in some localities. Careful study of these may lead to further light on the plant-life of Kansas in Jura-cretacic times.

The false-bedded structure, the drifted logs and cycads, and the bands of lignite all testify that this sandstone was deposited in littoral waters.

[‡] First Report of Maryland, page 42, January, 1860.

[§] See *Bul.* Washb. Coll. Lab. Nat. Hist. No. 10, p. 66.

Cheyenne sandstone is for the most part overlaid with the
nian shales, or immediately with the shell-conglomerate
of Belvidere section); but in a few localities the shales
ore or less of the sandstone itself have been eroded, so that
emains is covered with fluviatile Quaternary and recent
eposits. On some of the valley slopes of Soldier creek,
e east line of Kiowa county, ledges of Cheyenne sandstone
seen overlaid with calcareous marl, sand, and gravel.
e latter is disintegrated Loup Fork conglomerate, is shown
traces of incrustation with characteristic Loup Fork cement.
Comanche county "Natural Well" above-mentioned, the
ne stratum forms a considerable part of the wall and is
beneath recent alluvial.

he extent of the Cheyenne division beyond the limits of
r counties above mentioned, little can now be said, aside
peculations as to its equivalency to the Potomac and Trin-
isions. It seems to be lacking in Clark county, where
nian shell-conglomerates and shales, similar to those which
the Cheyenne sandstone on the Medicine Lodge river, rest

misunderstood the stratigraphic relations of that region, and referred this sandstone to the Benton. It was subsequently visited by Mr. Robert Hay, who referred it to the Dakota (Tran. Kan. Ac. Sci. X, 22). Still later, it was reconnoitered by Prof. Orestes St. John, who likewise referred it to the Dakota (Fifth Bienn. Rep. Kan. State Bd. Agr., Part II, p. 143).' Since the fall of 1884, I have had frequent opportunity of studying the region in which the Cheyenne division occurs, and some preliminary results of that study were published in No. 9 of the Washburn College *Bulletin*, under the title "Geological Notes on the region south of the Great Bend of the Arkansas River." In that article (p. 35) I have briefly redescribed the Cheyenne sandstone and placed it, in my Belvidere section, at the base of a series of shales which I provisionally referred to the Comanche series. Though at that writing I suspected its identity with the Dinosaur sand (later called Trinity division) of Prof. Hill, I contented myself with pointing out the probable age of the overlying shales and giving a section showing the relations of the sandstone to the latter. On receiving my paper, Prof. Hill expressed his belief that the sandstone in question was probably referable to his Trinity division (Ann. Rep. Ark. Geol. Surv. for 1888, II, 115). The data which the writer has acquired touching the Cheyenne sandstone tend to confirm this opinion and the suggestion also made by Prof. Hill (*op*, *cit.*, p. 179) that the Trinity division is allied to the Potomac. Indeed, if the Cheyenne sandstone be referred to the Trinity division, the discovery of Purbeckian cycads in the Cheyenne, in connection with the previously reported occurrence of the same in the Potomac, adds a strong link to the chain of evidence associating the Trinity division with the Potomac.

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being well up above the gypsum, conspicuous, and quite unique. It may be designated as the 'Black Hill horizon.' The deposit from which the hill takes its name is a bed of carbonaceous and rapidly decomposing shale.

"In connection with the shale are found fragmentary seams of poor lignite. Immediately above and below this is a layer of shell-conglomerate,madeup largely of *Ostrea* and *Gryphæa*. Below these is a formation quite unlike any other I have seen or heard of in Kansas, and well worth a visit to the place to see. It is a variegated sandstone, unfortunately too friable for utility, but displaying a most beautiful variety of colors. Brown, purple, blue, crimson, scarlet, pink, orange, lemon-yellow, and white, these and many intermediate shades may be seen, in brightest contrasts and most delicate blendings. Streaked and interstreaked in a tortuous manner, clouded and blended, blotched and blurred, the dispositions of the colors are as endless as their shades."

assume that the Cheyenne sandstone is referable to the
livision, it is remarkable that *Ostrea franklini* should be
haracteristic of and, so far as now known, confined to the
rision in Texas and Arkansas, while in Kansas it is lack-
e same, but characteristic of the Neocomian series.
s appears that *Ostrea franklini* is common to the Trinity
s and the Neocomian of Kansas; and if, as claimed by
[*] the European analogue of *Ostrea franklini* is *O. acum-*
the Kimmeridge, it is not easy to see how the *O. frank-*
any weight in determiming whether the Trinity division
nearly related to the upper Jurassic or to the lower Cre-
The same difficulty remains if *Ostrea dubiensis* of the
ard Kimmeridge be considered, with Hill[‡], the European
O. franklini. *Pleurocera strombiformis* being common
Purbeck and Wealden (*fide* Hill), is likewise unavailable
erion. If the fact that the only known Upper Neoco-
ycadoidea (*C. inclus*, Carr) is a small species, conclu-
dicated that the forms of this genus underwent a gradual
on in size from the Purbeckian through Neocomian time,

the American Institute of Mining Engineers, February, 1890, and here desires only to describe more particularly the discovery of the unexpected and extraordinary thickness of coal-bearing rocks, which is stated in the above mentioned paper are at least 8,500 and possibly 10,000 feet thick.

During the winter of 1889 Mr. R. H. Sanders made a flying visit to the McAlester district on the line of the M. K. and T. railroad, and upon returning to Philadelphia informed me that the Coal Measures present in that (McAlester) basin were certainly 3,000 feet or more thick. Upon arriving on the ground in the spring of 1889 I was therefore prepared to find Coal Measures about equal in thickness to those of our Appalachian fields. Commencing exploratory work in the McAlester basin I soon became convinced that Mr. Sanders' estimate was substantially correct, but to his measurements I had subsequently to add somewhat more than 1,000 feet for measures not coming to the surface at McAlester and which underlie the McAlester coal bed.

The explorations were made for the Choctaw Coal and Railway company, then partially organized, the officials of which with commendable generosity have permitted publication of the results; which in similar cases are too often jealously guarded as private information too valuable to be given gratuitously to the public.

Continuing the explorations eastward from the McAlester field towards Arkansas, by tracing the Grady (lowest) and McAlester series of Coals, I was astonished to find a great mass of rocks also coal-bearing and lithologically quite similar, coming in above the McAlester basin series and evidently conformable to, and a virtual upward extension of, the series, making a total thickness of 8,500 to 10,000 feet. Unfortunately the time and facilities for careful study and accurate measurement could not be had, and I was forced to be content with an estimate made by calculation from distances measured by an odometer attached to a "buck-board" wagon.

This great mass of coal-bearing rocks is found in the Kavanaugh (or Cavanal or Cavaniol or Cavanaugh) mountains 15 to 30 miles west of the Arkansas state line and north and west of the St. Louis and San Francisco railroad.

Starting at Bryan station on that railroad where the Grady (lowest) coal is opened and worked, and passing almost due north to and across the Kavanaugh mountains, a distance of five or six

whole series is crossed, and an accurately surveyed line
d give the data for a cross-section showing its true
The dip is constantly to the north, being about 40 de-
he Bryan mine and gradually decreasing until the forma-
t under the centre or backbone of the Kavanaugh range.
ss the results of Mr. Winslow and his successor in the
fields will show the existence of nearly the same thick-
I believe the Poteau and Sugarloaf mountains on the
line are geologically the equivalents of the Kava-
ge in the Choctaw country.

neral way the formation is divisible into an upper and a
l-bearing or "productive" series, each carrying workable
oal,—that is, beds from 3 to 5 feet thick,—with an in-
"barren" series in which no large beds of coal have
ound. These are possibly the same with Mr. Winslows'
l "upper" and "lower" series in his preliminary re-
888,* but the thickness assigned his "lower" series is
hundred feet while the "lower" series in the Choctaw
over 3,000 feet, which difference may prove to be merely

principal facts hitherto collected on this interesting subject, with references to the reports and publications in which details are given. The following is an abstract which I send to the GEOLOGIST. The subject is regarded as an important one, and has occupied the attention of geologists for many years, as eastern Canada is the battle ground, so to speak, of the advocates of the rival theories of continental glaciation and floating ice. The results thus far obtained from a somewhat careful study of its glacial phenomena, however, point to conclusions which are at variance with those held by extreme glacialists, and show that the theory of local glaciers upon the more elevated portions of the country and icebergs or floating ice striating the lower costal areas during the Post-Tertiary submergence of these, as maintained by Sir William Dawson, will serve to explain all the observed phenomena. The term 'local glacier' I define as an ice-sheet limited in extent, that is, confined to one valley or hydrographic basin, whether large or small, and influenced in its movements by local topographic features, such as mountains, water-sheds, hills, or the valleys of the larger rivers. The data have been collected chiefly by the staff of the geological survey; but Sir William Dawson, who has long studied this region, and others have done much valuable work in glacial geology here.

In reference to the origin and movements of local glaciers, it may be stated, that the main facts pertaining to each centre of dispersion, when correlated, show that these glaciers were independent bodies which had large gathering-grounds upon the higher parts of the country where snow fields and *névé* must have existed. Whenever motion began this snow and *névé* became converted into glacier-ice. Upon areas where they never underwent change into ice no striation of the rocks took place. In their movements the glaciers, generally speaking, followed the slopes of the land or the present drainage channels. Some of them seem to have been quite large, and those from adjacent drainage areas may have coalesced on the lower grounds and become confluent. At all events, the slopes and costal tracts are usually more glaciated than the interior and higher grounds.

In Nova Scotia there was a shedding of ice from the Cobequid mountains northward and southward, and the South mountain appears also to have sent glaciers down its slopes, on either side. Sir William Dawson, Dr. Honeyman, Mr. H. Fletcher, Dr. R. W.

others have made numerous observations showing many courses of striæ, which are explicable only on the theory laciers and icebergs.

in water-shed of New Brunswick, which traverses the rom north-west to south-east, sent off glaciers in nearly irections, or north-eastward towards the bay Des Cha- gulf of St. Lawrence on the northern slope, and ward towards the bay of Fundy on the southern slope. bundantly proved by data collected by the writer and

rable areas in the interior of this province, where centres ion for local glaciers existed, are unglaciated, no ice- tever nor boulder-clay being seen, and the loose ma- nsisting largely of rock debris *in situ*. These were now-fields and gathering grounds for the ice during the riod. The glaciers on the southern slope appear to have larger than on the northern. But even upon the y had numerous local and divergent movements, as the hows.

ickaback or Notre Dame mountains in south-eastern ice-sheet moving from the Laurentides across the St. Lawrence valley over the summits of the Appalachians and down the New England slope to the Atlantic. But it appears the evidence at hand does not support this view. The Archean area has, however, sent sheets of ice down its slopes in all directions around its circumference. In the central part, on the east side of the Hudson bay, they moved directly westward into its basin. In Hudson strait, according to Bell, the ice had a northeastward and eastward flow. Whether the whole Archean area was covered by glaciers flowing outwardly from the centre towards the circumference, or with snow fields forming the *névé* of local glaciers, as seems more probable, is a question to be decided by future investigation. Areas of unglaciated rock surface, doubtless, occur there as well as upon other elevated portions of eastern Canada where decomposed rock lies undisturbed except from subaerial action.

The extent and thickness of the glaciers cannot as yet be satisfactorily determined; but they seem to have been largest on the southern slopes of the Appalachians and Laurentides. The cause of this is not evident; but as regards those of the first mentioned mountains, which are in a part of the country with which the writer is most familiar, it may be owing in some measure at least to the difference in the steepness of the slopes on either side of it. The south-east slope is long, much broken, and has numerous comparatively level areas upon it. As the rate of motion would be slower on this slope, the ice would necessarily accumulate in larger sheets in depressions and on the level tracts. On the shorter and steeper slope of the St. Lawrence the motion of the ice would be more rapid, and it would more readily debouch into the estuary or sea.

Evidences of the action of icebergs or floating ice are found in the St. Lawrence valley and on the bay Des Chaleurs coast, also in a number of other places around the shores of the gulf of St. Lawrence. So far as the writer has observed, they are met with only on ledges below the 200 to 350 feet contour-line above sea-level. Floating ice seems to have played an important part in transporting boulders over the submerged areas.

The views here briefly outlined will doubtless undergo some modification, when this region, especially that part of it known as the great Archean area, comes to be studied in greater detail.

however, the main conclusions herein advanced will

undland, although not forming part of Canada, is geo-
lly connected with it, and its glacial phenomena may
be referred to here. The late Alex. Murray, C.M.G.,
of the Geological Survey for many years, states that its
s everywhere glaciated.[2] He held the theory of a conti-
e-sheet, however; but his facts show that the striæ are
ergent, following depressions and valleys in different di-
It seems probable, therefore, that here, as in eastern
local glaciers produced the chief striation observed, as
ut by the late captain Kerr, R. N.[1] But from its insular
and lying as it does in the track of the arctic currents,
areas must have been intensely eroded from icebergs and
ce.

EDITORIAL COMMENT.

nearly 300 persons. The seats rise gradually from the basement to the first floor. On the west side are four large rooms, one above the other, with dimensions 86x36 ft.: the lowest one is used for laboratory work, the two middle ones for public museum rooms, and the fourth one in the attic for storage purposes.

The first floor is devoted to geology. The spacious museum room contains the large Cooper collection of minerals; and a most unique and valuable collection of Dakota sandstone fossil leaves, made by judge E. P. West. Fossil shells of all kinds, immense saurians, horses, sharks and a life size cast of Megatherium cuvieri also find a place here.

The collection of vertebrate fossils from the Niobrara section of the Cretaceous formation in western Kansas, is pronounced by Dr. Geo. Baur to be the finest collection on exhibition in either Europe or America. This collection contains many remarkable saurians, fishes and birds including a Mososaur with the dermal scales in perfect preservation. The latter specimen was discovered by Prof. Snow in 1878, and has never been duplicated. Another unique specimen is the fossil feather of a Cretaceous bird, discovered last summer by judge West, and the only bird feather yet found in America below the Tertiary.

Prof. S. W. Williston, professor of anatomy in Yale Medical School has accepted the chair of geology, and will begin service September 1st. Professor Williston was for years professor Marsh's right hand man, and is also the most eminent authority on *Diptera* in the country.

All work in Zoology and Botany is done on the 2d floor. Professor Snow, while the chancellor of the university, is still director of the museum, and has a supervision over all departments. His specialty has been entomology, especially from an economic standpoint, and the university possesses the largest collection of insects to be found in any American college with the exception of the one at Cambridge. V. L. Kellogg is the assistant in entomology. He is a graduate of the department and has contributed to scientific knowledge by his observations on the *Mallophage*.

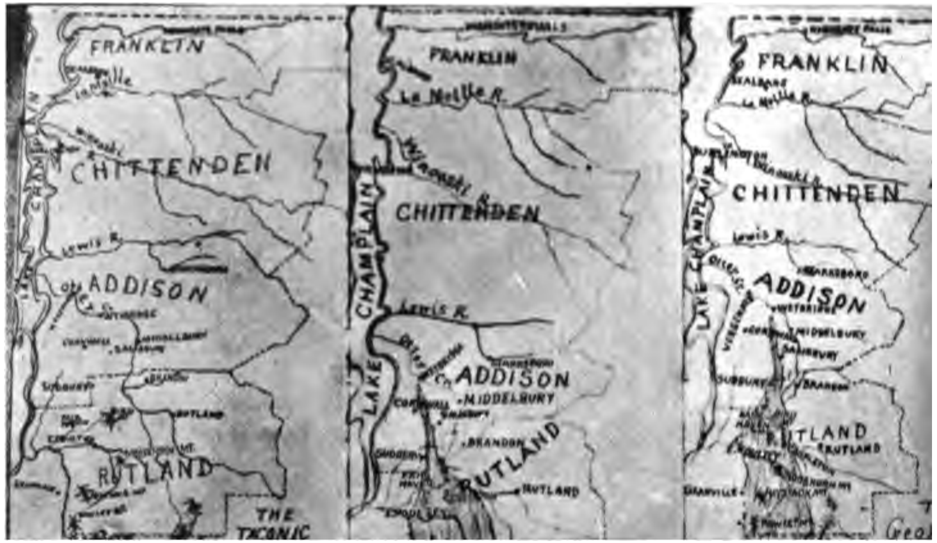
Work in botany is directed by Mr. W. C. Stevens, also a graduate of the University of Kansas. He is aided by a large herbarium of North American plants, collected by professor Snow.

f. L. L. Dyche, in the chair of Anatomy and Zoology, has
up a magnificent collection of American birds and mammals.
said to be the most accurate taxidermist in the country ;
is striking groups of grizzly bears, mountain lions, Rocky
tain sheep and goats, and buffalo are evidence of his skill.
ssor Dyche shoots nearly all the animals he mounts, spend-
ost of his vacations in the field. He is now preparing for
cond trip to northern British America, to hunt moose and
u. He is assisted by Miss Gertrude Crotty in anatomy, and
D. Eames in taxidermy.

e rooms of Snow Hall are heated by steam, the "indirect"
d being employed to furnish the rooms with fresh air, and
rect method for securing proper temperature.

sh air is introduced into the building by means of a "plenum"
ding under the entire building and connecting with the outer
arched openings and areas. Ventilation is accomplished
ans of large flues leading from floor to ceiling of all rooms,
rge iron chamber in the attic, in which sufficient radiation
ted to secure a sucessful movement of the foul air through
tilating cupola to the exterior.

SNOW HALL OF NATURAL HISTORY, UNIVERSITY OF KANSAS, LAWRENCE.


FRANKLIN
CHITTENDEN
Lewis R.
ADDISON
RUTLAND
THE TACONIC
CHAMPLAIN
FRANKLIN
Le Moille R.
Winooski R.
CHITTENDEN
CHAMPLAIN
Lewis R.
LAKE
ADDISON
MIDDLEBURY
BRANDON
RUTLAND
RUTLAND
FRANKLIN
La Moille R.
Winooski R.
CHITTENDEN
Lewis R.
LAKE CHAMPLAIN
ADDISON
MIDDLEBURY
SALISBURY
BRANDON
RUTLAND
RUTLAND
GRANVILLE
Geol

WHAT CONSTITUTES THE TACONIC RANGE OF MOUNTAINS.

Dr. Asa Fitch describes the Taconic mountains in the following words: Runs along the east line of this county, immediately on the Vermont side of that line. From Mt. Anthony in Bennington, it passes through Spruce (or West) mountain, Red, Equinox Bear, Antonio, Rupert and Pawlet (two names given to one long mountain) to Haystack, east of Granville village. (HISTORICAL, TOPOGRAPHICAL AND AGRICULTURAL SURVEY OF THE COUNTY OF WASHINGTON, 1849, p. 936.)

Prof. J. D. Dana describes the Taconic range of mountains in the following words, so far as they exist in Vermont: This great slate belt extends from Weybridge on the north to the southwestern corner of the state, widening southward and spreading into the state of New York. The part south of Brandon has been called the Taconic range of mountains, it being properly a continuation of the Taconic range of Massachusetts. [*Am. Jour. Sci.* (3) XIII. 336, 1877.]

Geologically these hills consist, according to Mr. C. D. Walcott's geological map of the Taconic region, of "Cambrian" formations, *i. e.* of Taconic or primordial strata. [See his map accompanying his papers on THE TACONIC SYSTEM OF EMMONS AND THE USE OF THE NAME TACONIC IN GEOLOGIC NOMENCLATURE. *Am. Jour. Sci.* (3) XXXV.] He also says: Fossils occur more or less abundantly at over 100 localities as now known to me within the typical Taconic area, and they are distributed at various horizons throughout the 14,000 feet or more of strata referred to this terrane. [*Am. Jour. Sci.* (3) XXXV. 242.]

This is a direct and complete verification of the claims of Dr. Emmons in the establishment of the Taconic system on the rocks of the Taconic mountains.

Thine own mouth condemneth thee and not I: yea, thine own lips testify against thee. Job xv., 6.

IEW OF RECENT GEOLOGICAL LITERATURE.

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merican *Geological Railway Guide*, giving the geological forma-
every railway station, with altitudes above mean tide-water,
interesting places on the routes, and a description of each of
ations. By JAMES MACFARLANE. Second edition, revised and
, edited by JAMES R. MACFARLANE. D. Appleton & Co., 1890.

rst edition of this convenient manual appeared twelve years
d at the time of the author's death, in 1885, he had prepared
of the chapters for this second issue, and had published ad-
eets of the part relating to the Dominion of Canada. Its com-
has been accomplished as a work of filial love by his son, during
ments of leisure that could be spared from a busy professional

lan of the book is to give the names of the successive railway
, with their distances in miles from the beginning of the line,
inst each to state the geologic formation exposed there, and its
feet above the sea. Copious notes also call attention to locali-
uarries, mines, oil and gas wells, the best points for collection

genus Platyceras. There are also incorporated many new observations derived from an exhaustive study of a large number of specimens collected during the past few years; besides an examination of nearly all the types of the different forms. Of a single species more than three hundred specimens were obtained from a single locality for the purpose of determining the limits of variation. Although it is to be regretted that the familiar name established by Conrad nearly half a century ago is to be given up, it is thought that the change will be a great advantage in the consideration of this group, since it has long been regarded, particularly by those palæontologists who are somewhat familiar with recent shells, that Conrad's group actually formed a part of Capulus of Montfort. After a brief review of the nominal history of the group, the habits of the ancient Calyptræus are discussed. This refers chiefly to the attachment of the gasteropod shells to crinoids; and the consequent variation in the form of the shell and range of variability. The descriptions of numerous illustrative examples are given at length. This intimate association of crinoid and gasteropod has been noted in the cases of at least a score of species of the former, and nearly a dozen of the latter. These are given in tabulated form. It must be borne in mind that the close relations of the two forms do not imply that the gasteropod was parasitic in its habits as is generally regarded but that the mollusk, though for a greater part of its life stationary, probably fed only on the excrementitious matter of the crinoid and on the minute organisms brought near by the slowly waving arms of the echinoderm.

The remarks on geographic and geologic distribution have a wide application. The relation of the forms from the Burlington and Keokuk rocks is very significant in its bearing upon the true connection of the two formations. Following the last section is a stratigraphical catalogue of the known forms, a discussion of the generic characters and an enumeration of the recognized species: of the latter new descriptions are made from the abundant material examined. Each description is accompanied by a full bibliography and a complete discussion of the leading characteristics, peculiarities and other points of interest. Twenty-two species are regarded as valid. The closing section is devoted to brief remarks on the spurious and doubtful species. A plate of twenty-three figures of the most peculiar forms, and species never before figured, accompanies the monograph.

Meteoric Irons. GEORGE F. KUNZ, in the Trans. N. Y. Acad. Sci., Vol. IX, No. 8, May-June, gives some interesting descriptions of various meteorites. In the first paper (pp 186) are described about twenty or more meteorites recently discovered in Brenham twp., Kiowa county, Kansas. The masses range in size from 466 lbs. to 1 lb. and less. Two of these masses (345 lbs. and 75 lbs.) belong to the caillites, the others, containing olivine, to the pallasites. Analyses of the iron gave Fe. 88.49; Ni. 10.35; Co. .57; Sp. gr. 7.93. Mr. Kunz says: "This group of meteorites possesses more than ordinary interest on account both of the peculiar composition and structure, and also of the

bted ethnological relation, especially because of the probable con-
n with the meteoric iron found in the Turner Mounds (Ohio).

second paper (pp. 194), "Meteoric Iron from Bridgewater,
Co., N. C." This mass originally weighed 30 lbs., has a sp. gr.
7 and contains Fe. 88.90; Ni. 9.94; Co. .76; P. .35; Cl. .02. The
nnstätten figures were developed. The third paper (pp. 196),
oric Iron from Summit, Blount Co., Ala." This mass weighs
., sp. gr. 6.949, comp., Fe. 93.39; Ni. 5.62; Co. .58; P. .31; con-
large quantity of free chloride of iron. Instead of the Wid-
tätten figures there was developed a banded appearance. Fourth
on "Meteoric Iron from Colfax twp., Rutherford Co., N. C."
a small mass weighing 72 Troy ounces. Composition very var-
ranging Fe. 87.69 to 89.22; Ni. 11.26 to 9.37; Co. .62 to .53.
paper (p. 198) short description of a stone which fell at Ferguson,
od Co., N. C., July 18, 1889.

n paper (p. 201) is a most interesting one on the "Aerolites
fell May 2d, 1890, in Winnebago Co., Iowa." Over 500 pieces
shower have been recovered; the largest of these weighs 85 lbs;
allest $\frac{1}{20}$ oz. This meteor is a typical chondrodite, porous, with
r. of 3.638. According to L. G. Eakins the approximate com-
n of the mass is: Nickeliferous iron, 19.40; Troilite, 6.19; Sili-
oluble in H Cl, 36.04; Silicates insoluble in H Cl, 38.37.

chert is interesting from the fact that, from what we know of modern Radiolaria of the Challenger Expedition. Furthermore this Silurian Radiolaria, we may infer that we have in these old chert beds a true deep sea deposit of Palæozoic origin. The paper enumerates twenty-three species distributed among eleven genera.

Notes on the Leaves of Liriodendron. By THEODOR HOLM. (From the Proceedings of the United States National Museum, vol. xiii, 1890, No. 794, pp. 15–35, pl. iv–ix.)

This paper gives the result of a study of the variation of leaves from the living *Liriodendron tulipifera L.* and then takes up the so-called fossil species of Liriodendron and considers that "these ancient American types have shown a liability to variation in the same degree as our recent form." The aim of the paper is very clearly stated on page 16, where the writer says that "The object of these notes is to prove that, as far as is known to the author, there is not a greater difference in the foliage between many of the extinct species of *Liriodendron* than between a series of leaves from a very young tree or from a branch of an older one of our recent species." The article may be regarded as a protest against the undue haste of paleobotanists generally to rush into "species making." Until within a comparatively recent time there was the same passion for "species making" among paleozoologists; but, now with the more careful writers there is a greater effort directed toward the combination of variations of a species than to the description of so-called new species. This great variation in the form of leaves, not only from different trees of the same species but from an individual tree, emphasizes to a geologist the greater value of paleozoology than of paleobotany for the purposes of stratigraphical geology.

The author's use of geological terms shows that he has not so thoroughly mastered the details of that science as those of botany.

Mineral Resources of Michigan. CHARLES D. LAWTON. Robert Smith & Co., State Printers, Lansing, Michigan. 8 vo., pp. 181, 1890.

For mine owners and others directly interested in the actual and probable out-put of the various mines this is a valuable report, giving as it does, an account of the location, size and condition of each of the mines, and a detailed record of the business of each company for the past year. The subject of accidents in mines and means of preventing them has been treated ably by Mr. Lawton in former reports and is mentioned incidentally in this one.

The report contains very few of the facts which a commissioner of Mineral Statistics has such abundant opportunity for observing and collating, facts which would lead to a clearer understanding of the origin of the various ores, and their genetic relationship to the rocks in which they occur. These are questions which can never be too carefully studied, and a few facts observed at each mine, and reported merely as facts, even without any attempt to explain them, might result in throwing great light upon some of these unsettled problems.

port is an interesting and valuable one; and Michigan sets an which it would much benefit some of her sister States to follow, eation and maintenance of a capable commissioner of mines and statistics.

l Report of the Department of Mines, New South Wales, for the 9. Sydney; 1890. This report is a royal octavo, paper bound f 253 pages, and is devoted to the mineralogical products and l structure of the several mining districts of New South Wales. he minerals of the region are mentioned gold, coal, petroleum , copper, silver and lead, iron, antimony, platinum, bismuth, d nickel, manganese and zinc, graphite, mica, diamonds.

some of the interesting tables with which the report we learn that the annual output of coal in New South Wales ased in value from £603,248 in 1881 to £1,632,848 in 1889; uce of the gold mines for 1889 was worth £434,070, and the all mineral products for 1889, £4,780,365. In 1889 the iron amounted in value to only £18,330, while the value of the tin re foots up £415,171.

Silurian limestones and shales, with possibly earlier rocks, constituting the Arbuckle—Wichita mountain system.

These rocks extend north 40° in a series of vertical folds forming low treeless ridges, as far west as the staked plains, the Red, Canadians, Washita and Arkansas rivers all being influenced by this trend between the 97th and 100 meridians.

The folding and great denudation of the whole region are remarkable, the whole series from supposed Permian to the base of the Silurian occurring mostly in vertical stratification. There are clearly three great trends throughout the region, (1) a trend from northeast to southwest, as seen in the Kiamitia and Stringtown mountains, which, west of the Tishomingo granite area in the Silurian area is succeeded by (2) a northwest trend, and (3) a later trend of E. 20° N. which has clearly dislocated the former and older trends as shown by the remarkable S shaped dislocations visible all the distance across the Nation. Concerning the age of these trends, it is clear that they have taken place in part since late Carboniferous time, as the rocks of that period are involved in each. I do not mean to say, however, that earlier folding may not have occurred in the Silurian rocks. It is also evident that great disturbance has taken place even in post-Cretacic times, for the Red river flows in a fault through Upper and Lower Cretacic rocks north of Denison with a northern downthrow of nearly a thousand feet. No upland drift material was found, although Red river has cut down 50 feet below its ancient Quaternary river sediments. I hope to present these results more fully at an early day. R. T. HILL.

THE TEXAS CRETACEOUS. In your last number there was a kind notice of my "Check List of the Cretaceous Fossils of Texas." The concluding sentence may be misleading, however. It reads as follows: "The list proves evidently that all the Cretaceous strata in Texas are "more recent than the English Gault." The object of preparing this list was to show for the first time the stratigraphy of the numerous supposed Cretaceous species, and to show their faunal associates in order that the world could have some bases for comparison. No where in the list do I commit myself to an opinion, as to European equivalency for I become more and more, each year, indisposed to correlate our Texan strata with those of Europe alone. I do believe in trans-oceanic correlation, when trans-oceanic faunas are the same, but, it has been utterly impossible heretofore to even have a basis of comparison, without such a list as I have endeavored to give.

I do believe that the Texas alleged Cretaceous strata contain forms which in Europe are characteristic not only of the Gault, the Neocomian, the Wealdan, but of the Jurassic, but the stratigraphy must be studied and unravelled before they can be discussed.

This is now my fifth consecutive month of field study this year upon the Texas Cretaceous strata north of the Colorado river, and notwithstanding my years of previous labor, every day yields some new and important light. How then can we correlate and locate these marvelous beds with European strata?

een preparing for several years, however, a paper on the
logic Position of the North American Cretaceous," which I
sh (d. v.) in time for the International Congress provided I am
to present it, in which I will try to correctly present the

Very truly yours,

Texas, Aug. 15, 1890. ROB'T T. HILL.

TWOODS. Between Louisville, Ky., and old Dêposit Station,
of the Louisville and Nashville R. R. there is an extensive
at the foot of the Knobs, known as "The Wetwoods." It
oted not only for its wetness, but for the lawless character of
ants. A system of drainage, however, has not only improved
ut the morals of the people, and one may now pass through it
although the old lawless spirit will show itself occasionally in
urder and violence. During a residence of five years in
I have taken many a weary journey through that section of
ying to solve the problem of its origin. At first it seemed as
t continental ice-sheet, or spurs of it, must have scooped out
in question, and also rounded out the adjoining knobs into
liar contour, but subsequent investigation has led me to aban-
iew, although glaciers doubtless played some part in it. A
ination of this region shows that the basin itself is indented
rous channels that seem to correspond with the breaks in the

to twenty feet in thickness, is the result of weathering seems to the writer preposterous. It is either fluviatile or glacial in character. Quite a large number of sandstone boulders have been collected by the writer, and their position in the clay seems to indicate that they are glacial in origin. The knobs, on both sides of the Ohio river, though much broken, remain as hills where streams have not been large and powerful enough to wear them down to the deeper valleys, like the so called Collett glacial valley in Indiana, which by the way, is a *pre*glacial valley, and was long in existence before the ice-sheet covered it. Both arms of the knobs stretch out from the river for the distance of about eight or nine miles, and both break off in the same peculiar way, like the back of a dromedary between the head and the hump. The cause of these breaks where the knobs disappear is the Silver creek channel on the Indiana side, and Fern creek and Salt river, on the Kentucky side. I have been unable to trace out these ancient channels in all of their former ramifications, and it is doubtful if their connections can be exactly determined, but a close examination of this region under consideration, will convince any one familiar with such phenomena, that preglacial streams acting with the ice-sheet operated in the formation of this basin known as the Wetwoods.

Near Old Deposit station, in the center of this depression is a conical hill, perfectly round, which looks as if it might be artificial, but the sweep of the old channels around it bespeak its origin. It seems to have been the site of an Indian village as great numbers of broken flints and arrow-heads can be picked up on its southern slope.

Louisville, Ky., June 9th, 1890. JOHN BRYSON.

PALÆONTOLOGICAL NOTES FROM INDIANAPOLIS. (A. A. A. S.) PTERICHTHYS — CASTOROIDES — EURYSOMA *g. n.* Prof. H. S. Williams of Ithaca exhibited a new and unique specimen of which fragments had been previously known. It consisted of several plates of a large fish from the Catskill of New York. The first description of a fragment of this species was published by Prof. E. W. Claypole in 1883, in the proceedings of the American Philosophical Society, under the name of ***Pterichthys rugosus.*** Its most notable character is the rugose, radial markings on the surface differing in this respect from any known fossil fish. A second plate has since come into possession of the author of the species which was evidently a lateral plate of the same animal. It is deeply concave and has a similar wrinkled surface.

In the original description the following remark occurs:

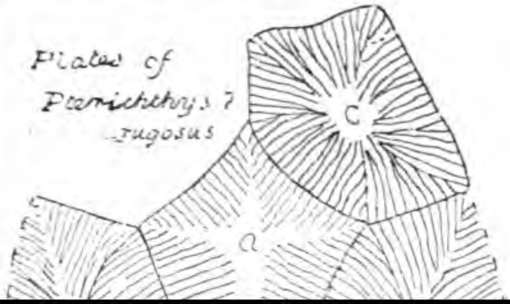
"The outline of the plate corresponds very closely with that of the dorso-median plate of Pterichthys, and were it not perfectly flat I should be inclined to refer it to that part of the exo-skeleton. But this flatness renders it probable that it is the ventro-median or well known "lozenge-plate" of Hugh Miller, the central piece of the armour of the fish on the lower side—overlapped on all sides by the others."

But the additional evidence now attained renders it more probable that the first impression was the correct one, and that the plate in question

he dorso-median, in spite of its perfect flatness. Prof. Wil-
imen exhibits it with three other plates evidently in correct
ip to one another.

well to be too confident regarding the details of a creature
ve as yet know so little, but it seems in the highest degree
hat the two larger plates are the post-dorso-laterals and the
post-dorso-median. On that view it is also almost certain
dditional plate above mentioned which has not yet been fig-
vhich came to hand about four years ago, is the dorso-latera-
side.

view the following outline will represent the position and re-
ll the yet known plates of this fish.


Plates of
Pterichthys ?
rugosus

appears on the corresponding plate in either of the two fossils thus far found.

Dr. Newberry, who has seen a print of the specimen, is of opinion that the characters justify a separation from *Pterichthys* and *Bothriolepis* (genera scarcely at present clearly distinct), and has proposed the name *Holonema* in allusion to the wrinkled surface. There are certainly great differences between this fish and the other two genera—differences perhaps sufficient to justify separation—in the larger size of the former, the flatness of the dorso-median plates, and its position with the long and narrow end behind. But as to the sculpture it is doubtful if the difference on this point is great enough to justify another name. Though that of *Pterichthys* is usually considered tubercular, yet a slight examination of specimens, especially those from Scaumenac Bay (*Pt. canadensis*), will show that it is frequently rugose and that the tubercles constantly tend to run together into wrinkles. Hence that species is now often referred to *Bothriolepis*. From the latter the great size of the fossil in question is the main point of distinction. For the present, however, the matter must remain undetermined, and the fossil be called *Pterichthys* (Both.) *rugosus* or *Holonema rugosum*. It is right to add that the exact horizon of the fossils is a little uncertain. They came, however, from either the highest beds of the Chamung or the lowest of the Catskill.

Since the above note was written Dr. Newberry's admirable work on Carboniferous Fossil Fishes has been distributed. Among the species there described is the fossil in question, several plates of which are figured in whole or in part. The central plate (a in diagram) is referred by Dr. Newberry with hesitation, as it was in the original description, to the ventral surface and considered the equivalent of the "Lozenge-plate." It is with diffidence that the writer ventures to differ from so eminent and experienced an authority, but the evidence now accumulated, and especially the fossil exhibited at Indianapolis, seem to leave little or no ground for hesitation. The form of the central plate, the presence of another median plate at its narrow end, the form, size and fit of the lateral plate at its wide end, the direction of the wrinkles, and the number of plates necessary to complete the shield (assuming its near relationship to *Pterichthys* and *Bothriolepsis*, which seems reasonable), all combine to indicate the dorsal rather than the ventral aspect of the fish. The only rebutting evidence is the flatness of the central plate and perhaps its position with the wide end in front, though the last may have little or no significance. There seems to the writer insufficient reason for overlooking the manifest analogy with the dorsal shield of *Pterichthys*.

It is only fair to add that Dr. Newberry's opinion above quoted is merely provisional and therefore subject to revision. It was moreover published before the discovery of the specimen shown at Indianapolis, and consequently the evidence much less complete than what we now possess.

Prof. Joseph Moore, of Earlham College, of Richmond, Ind., exhibthe most nearly complete skeleton of the great fossil beaver ohioensis) that has yet been discovered. Probably had the nown in time or had the workmen who were digging the the value of the bones the entire skeleton might have been

yet possess no perfect specimen though it ranged over a wide area in North America. In size it must have been about that of a black bear.

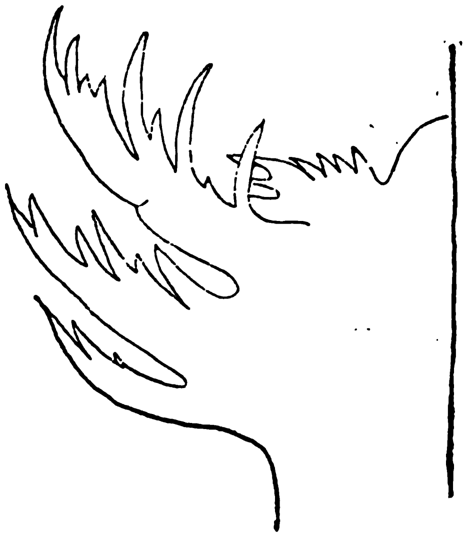
Mr. C. E. Newlin, of Kokomo, Ind., exhibited some tracings from slabs of water lime found in the quarries near that city, which show the outlines of several Crustaceans belonging to the genera Eurypterus Ceratiocaris. These impressions, for they are scarcely more, have been known for eight or ten years past to the workmen as "petrified crayfish" and occur scantily in only one particular ledge of the stone. Some of them so far as could be determined by a hasty examination belong to the species *Eurypterus lacustris.* Others apparently differed and may prove to belong to species yet undescribed.

But a few of these fossils differ so far from all known eurypterids that they must be regarded as representing another and new genus of Crustaceans. The form of the body and the appendages is remarkable and very clearly shown. A full description of this fossil is appended.

Genus (Eurysoma).

Body ovate, narrower in front, abruptly tapering behind into a cylindrical abdomen ending in a spiniform tail.

Head-shield entire, roundly triangular, bluntly pointed in front. Number of segments in thoracic portion uncertain, six visible in the specimens described, ending on each side in a backwardly directed point. Abdominal segments four, subquadrate; beyond these is a sharply triangular spine.



Appendages consist of five pairs of organs the first four of which taper rapidly to a point and are furnished on one or both sides with spines or spinous processes. The fifth pair or the so-called swimming feet, are much thicker and longer than the others and show no trace of che-

gs. They are apparently two-jointed, consisting of three por-
gments, but in the condition of preservation show no details
e. As in Eurypterus a fringe of stiff hairs or bristles surrounds
and perhaps covers the whole surface of these swimming feet.

EURYSOMA NEWLINI, s. n.

measuring over all about 10 to 12 inches or even more in
4 to 5 inches in greatest breadth. The length may be allotted
rage thus: Head-shield, 2 in., body, 3 in., abdomen, 4 in., tail-
.; greatest breadth of body somewhat behind the middle.
appendages the foremost pair is the smallest with about 5
ach; the second and largest pair have at least 12; the third
nd the fourth about 4 spines. From the second the appen-
nish gradually in size to the fourth.
e fifth pair reach only to the hind segment of the body—about
and show merely the details mentioned in the general de-

.—The peculiar form of this Crustacean differentiates it
m the following genera already known from North America.

ypterus.
ypterella.
Amphipeltis.
Stylonurus.
Pterygotus.
Dolichopterus.

ill is the difference between it and the family of *hemiaspids*,
strongly limuloid in appearance, whereas *Eurysoma* in this
ggests that genus but slightly. *Bunodella* is the only de-

PERSONAL AND SCIENTIFIC NEWS.

Prof. C. H. Gordon, of Keokuk, Iowa, has taken a position at the Northwestern University, Evanston, Ill. His future work will be in natural history and algebra.

The Fourth Annual Session of the Iowa Academy of Sciences was held at Des Moines, Sept. 4th and 5th. Mr. C. R. Keyes had the following papers: Evolution of Strophostylus, Age of the Iowa City sandstones and Notes on the Red Rock sandstone; Prof. R. Ellsworth Call read the following papers: Two Quaternary sections near Des Moines, On a Quaternary section eight miles southeast of Des Moines (in connection with Mr. Keyes). Prof. J. E. Todd had the following: Further notes on the geology of northwestern Iowa, Exhibition of volcanic ashes from Omaha, Nebraska, and Shore-lines of ancient glacial lakes. Prof. E. H. Barbour had a paper on Varieties and structure of oölyte.

The Summer Meeting of the Geological Society of America was held at Indianapolis, beginning Sept. 19. The following papers were presented: Recognition of mineral contours in thin sections (abstract), A. C. Lane, Houghton, Mich.; Geology of southern Indian Territory, R. T. Hill, Austin, Texas; The Vita crevasse, L. C. Johnson, Meridian, Miss.; The Cuyahoga shale and the Waverly problem, C. L. Herrick, Cincinnati, O.; The geotechnic and physiographic geology of western Arkansas, A. Winslow, Jefferson City, Mo.; The Appomatox formation in the Mississippi embayment, W. J. McGee, Washington, D. C.; The Redonda phosphate, C. H. Hitchcock, Hanover, N. H.; The continent and the deep seas E. W. Claypole, Akron, O.; The Taconic iron ores of Minnesota and western New England, N. H. Winchell and H. V. Winchell, Minneapolis, Minn.

The Colorado Desert. Mr. C. R. Orcutt, San Diego, has lately made an exploration of the arid region that forms the eastern portion of San Diego county, Cal. He reports the existence of large quantities of silicified wood, and the discovery of a coal-field, which he thinks is extensive and should have the attention of capitalists.

At the last meeting of the American Association for the Advancement of Science (Indianapolis), Section E was presided over by Prof. J. C. Branner, who delivered an address on the *Relations of the United States and State geological surveys to each other, and to the geologists of the country.* The secretary was Prof. S. Calvin, of Iowa City. Following is a list of the papers read before the Section:

tion of glaciated rocks—15 min.—By Homer T. Fuller.
hannel of the Niagara river—15 min.—By J. T. Scovell.
A few last words in reply to Mr. G. K. Gilbert's History of
agara river.—15 min.—By George W. Holley.
eposit of glacial gravel found in Park county, Ind.—10 min.—
n T. Campbell.
ng some portions of Castoroides ohioensis, Foster, not hereto-
own.—20 min.—By Joseph Moore.
rking Sands" of the Hawaiian islands.—10 min.—by H. Car-
Bolton.
ce of sonorous sand on the Pacific Coast of the United States.
n.—By Carrington Bolton.
, a new variety of Phosphorite found in Florida.—10 min.—
T. Cox.
mbia formation in the Mississippi embayment.—20 min.—By
McGee.
stitutes the Taconic mountains?—15 min.—N. H. Winchell.
ations and artesian wells of Memphis, Tenn.—15 min.—James
ford.
in morainic mapping.—15 min.—T. C. Chamberlin.
on construction of topographic maps for geologic reports.—10
Arthur Winslow.
the occurrence of Pegmatite in central Missouri.—5 min.—
Winslow.
unt of natural gas used in glass manufacture.—10 min.—Ed-
rton.
iation of subterranean water supplies.—10 min.—J. E. Siebel.
the qualifying conditions of successful artesian well boring in
thwestern states.—10 min.—C. W. Hall.
dike in the Minnesota river valley.—5 min.—C. W. Hall.

THE

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THE TACONIC IRON ORES OF MINNESOTA AND OF WESTERN NEW ENGLAND.*

By N. H. WINCHELL and H. V. WINCHELL, Minneapolis.

In the course of an investigation and report on the iron ores of Minnesota we have learned that there are five principal kinds of ore, and that while they differ mineralogically one from the other, and are associated with different mineral species, they also belong to different geological horizons. These five ores are as follows:

1. The hematites and limonites of the "Mesabi range," the equivalent of the manganesic hematites of the Penokee-Gogebic range in Wisconsin.
2. The gabbro titanic magnetites, whose stratigraphic place is near the bottom of the rocks of the Mesabi range.
3. Olivinitic magnetites and sometimes sulphur-bearing quartzose magnetites, whose place is just below the gabbro eruptive rock, and in the basal portion of the Mesabi rocks.
4. The hematites and magnetites of the "Vermilion range," extensively worked at Tower, belonging in the Keewatin formation.
5. The magnetites of the crystalline schists belonging in the Vermilion formation.

In our discussion of these ores we have attempted to indicate their probable equivalents, as to quality and stratigraphic horizon, in Canada and the eastern portion of the United States. We have little or no difficulty in designating those ores which, in strati-

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* Read before the Geological Society of America, Indianapolis, August 22, 1890.

position as well as in metallurgical quality, are the prob-
allels of the northwestern ores. These discussions and
sons will appear in a forthcoming bulletin (No. 6) of the
ta geological survey.

consideration, however, of the ores of the Mesabi range,
been led into a somewhat extended re-examination of the
of the ores of eastern New York and western New Eng-
d we desire to call the attention of geologists to some of
ts.

ave for some time considered the Mesabi hematites and
s, which are the unquestioned equivalents of the man-
hematites (with small amounts of limonite) of the Peno-
bic range on the south side of lake Superior, as belong-
e primordial zone of the stratigraphic scale. It is not
at any one will question this conclusion, as it has lately
firmed by the discovery of primordial fossils in the Ani-
ks of this region at points a few miles north of the inter-
line. The fossils have been examined and pronounced
Prof. G. F. Matthew.[*] It is in connection with the ores
ır in these rocks (making the Mesabi iron range of Minne-

If we consider further this general appearance of parallelism, in respect to their associated rock-strata, we find also a striking similarity. We know that the western ores of this horizon are uniformly found in close association with a dolomitic limestone, which is often quite siliceous, or "cherty." It often embraces lumps and apparently angular pieces of flint and jasper of bright colors. It has been described at some length by Irving and Van Hise in their late discussions of the iron ores of Wisconsin.* They estimate that this limestone is sometimes 300 feet thick, and that in other places it apparently is wanting. It has been described as *marble* where it appears at Menominee, but generally it is not in sufficiently large and even masses or beds to warrant that designation. It also appears at the same stratigraphic horizon in Canada, according to the descriptions of the Thunder Bay region by the Canadian geologists. In Canada, however, and in northeastern Minnesota, it has not attracted so general attention, either because it is not so largely developed, or because it has not yet been discovered in outcrop on so large a scale. Underneath this limestone, in Minnesota, is a conspicuous and persistent quartzyte which sometimes is vitreous. This is cut and interbedded with gabbro, and in large tracts is immediately overlain by the great gabbro sheet of that part of the state. This quartzyte has an observed thickness, in Minnesota, of not over 300 feet, but it may be over 500 feet thick. In Wisconsin it is estimated at 300 feet. Overlying the limestone, at least at a higher stratigraphic horizon (though the limestone may be wanting where this observation was made) are other quartzose strata, differing considerably from the lower quartzyte in being finer grained and often with limonitic streaks. Overlying all these strata are black slates with interbedded traps, passing upward into the quartzytes and traps of the Cupriferous (Keweenawan) formation of lake Superior.

If we compare this succession of strata with that of the Taconic region of western New England we are at once impressed with the close resemblance. Overlying the Archean of the Green mountains is the great "granular quartz," which has lately been shown by fossils to belong in the Primordial zone,** and which Dr. Emmons put at the base of his Taconic system. Above this is the great marble belt which Prof. Dana has traced from central Ver-

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*Am. Jour. Sci. (3), xxxvii, 32.

**C. D. Walcott, Bulletin No. 30, U. S. Geol. Survey.

to New York city, and which at Cortland is overwhelmed,
with the underlying quartzyte, by the gabbros of the Cort-
eries. This limestone Dr. Emmons styled Stockbridge lime-
and in his scheme he considered it as immediately superja-
the granular quartz. It is in this limestone, or in imme-
roximity to it, that occur all the iron beds of western New
nd, and of Dutchess, Columbia and Rensselaer counties in
ork. Prof. Dana has called attention to this association.
itchcock had done the same earlier. That this limestone,
furnishes large quantities of marble, which holds the
tes of the region, which immediately overlies a great
yte which is primordial, which has a dolomitic composition,
hich is overwhelmed with a gabbro outburst, should have an
parallel in all these respects in the northwest is certainly a
able coincidence of geological data that demands close at-
. These are the general considerations that impressed us
e probable parallelism of the Taconic ores of Minnesota
hose of western New England.

notwithstanding the necessity of a laborious reconsidering of the whole question, both in the west and in the east, was to make a hiatus in our investigation, and was to quail at the appearance of added work. We therefore decided to undertake to examine the problem again. It was divided into two parts and pertained to:—

1. Can there be any mistake in the stratigraphy of the Northwest, such as would, if corrected, allow of this quartzyte and this limestone (and particularly this limestone) being put into the strata of the second fauna?

2. Can there be any mistake in the stratigraphy of western New England which, if corrected, would allow of the Stockbridge limestone being put into the primordial zone?

It did not require a moment to answer the former question. There is no geologist who has examined the rocks of lake Superior who would not at once scout the idea of the Trenton age of any limestone in northeastern Minnesota. No one has ever suggested such a possibility.

We were therefore forced to seek for possible mistakes in the stratigraphy of western New England, as recently interpreted by Messrs. Dana and Walcott.

At the outset we find great confusion in the stratigraphy of western New England. If there be any part of the world where the strata have been variously interpreted, it is the Taconic region. Dr. Emmons' scheme was opposed by an influential school during his lifetime, but was virtually accepted when Barrande and Billings espoused his views on paleontological grounds. There were so many apparent irregularities and exceptions, not to say errors, in the stratigraphy of Emmons, that Prof. Dana reviewed the whole field on lithological and general stratigraphical lines and reached the conclusion that Emmons was wholly wrong, and that the Taconic system had no actuality as a sub-Silurian (Primordial) terrane, but that all the rocks included in it were of the age of the Champlain system of New York. Again, and lastly, Mr. Walcott has gone over the ground, in some parts of the field, and has found fossils enough to establish a great primordial (sub-Silurian) series, correcting Dana in respect to the quartzyte and the "great central slate belt," but approving Dana in respect to the Stockbridge limestone.

Now, it is this final conclusion, respecting this limestone, to which we wish to direct your attention. Does it belong chronologımediately above the quartzyte, and thus near the base of ıordial, or does it belong in the zone of the second fauna, valent of the Trenton, or the "Trenton-Chazy-Calcif-

ut just to Mr. Walcott to state that he did not give much to the stratigraphy of the eastern portion of the lime-lt in Vermont and Massachusetts, but accepted, and ex-on his map accompanying his last papers in the American of Science,* the conclusions of Prof. Dana, who, again, and perpetuated the conclusion of Rev. Mr. Wing, to the at the Stockbridge and Sparry limestones are the same in general, and that the differences of lithology, as well oticeable lack of fossils in the Stockbridge, or eastern due to greater metamorphism toward the east.

ısidering the possible distinctness of these two limestones, e some things that must be accepted as facts that cannot tioned. In general, all those facts of observation that n stated by good geologists have to be admitted. It is n inferences have been drawn from the facts which the not prove, that we are at liberty to suggest other infer-on the geological map of Vermont by Dr. Edward Hitchcock and considered by him a belt of Tertiary age, runs along the eastern edge of the limestone area and not far from the western edge of the quartzyte area, thus coinciding with the possible strike of a limestone of the age of that which accompanies the Taconic ores in Minnesota and Wisconsin.

We note next the existence, in northern Vermont, of another limestone which also has furnished a large amount of marble—known as Winooski marble. According to Mr. Walcott this limestone lies below the Olenellus fauna, and has not yet furnished any characteristic fossils.* He also says it is over seven hundred feet thick (reaching 1,000 feet) and is overlain conformably by 8,000 or 9,000 feet of slate and schists; and in other places he estimates these schists at 14,000 feet, and refers them to the great Georgia formation. The query naturally arises—may not the Stockbridge marble be on the horizon of the Winooski marble? And may not the schists and slates that make up the Taconic mountains—its conformable companions—of the Georgia formation? In the Winooski region, at any rate, there is a marble formation directly overlain by nine thousand feet of primordial slates and schists belonging to the Olenellus fauna. We notice that in continuing southward, while these schists expand into a great area, and really come to make the Taconic range of mountains, the underlying limestone, according to Wing, Dana and Walcott, disappears entirely; and although there is a great non-fossiliferous marble belt, the limestone which constitutes it is, on the same authority, of Lower Silurian age and overlies the same schists and slates—at least is of more recent date, although overlain by a second series of schists and slates. There is, therefore, no unreasonableness in suggesting that the Winooski marble may continue southward and deploy out on the flanks of the Green mountains, carrying with it its conformable companion, the Georgia slates and schists. We may go further and affirm that, in the absence of proof to the contrary, the Winooski marble would be likely to extend southward. Its extension southward would be in a direction parallel with the folds of synclinal and anticlinal axes. If the supposed extension were across such pre-primordial axes there would be reason to expect some of them might cut it off. We have, therefore, in addition to the certainty

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*Am. Jour. Sci. (3), xxxvii, 384; xxix, 330.

presence of the Trenton limestone in southern Vermont, the
ility also of the presence of the Winooski marble.

next proceed to consider the question in the light of posi-
cts bearing on the probable existence of the Winooski lime-
n central and southern Vermont and in Massachusetts.

find the earliest evidence comes from the researches of Mr.
as presented by Prof. Dana.

take up first those facts that tend to prove the existence of
ne limestone, and afterward those that tend to show the
ce of two.

Facts that indicate the presence of but one limestone. All
acts have been interpreted by Mr. Dana, and accepted by
alcott, as proving satisfactorily that there is but one lime-

Fossils at West Rutland. Great stress has been laid on
scovery by Mr. Wing. But if the description be examined,
nection with its accompanying map,* it will be seen that
idence is far from conclusive. The fossils are all in a com-
vely narrow limestone belt, which is isolated entirely from

(c) *Fossils at Hubbardton and West Castleton.* These are also far west of the great marble belt and in the midst of the "great central belt of slates," in narrow belts of limestone, one being but sixty yards wide. There is here no connection with the great marble belt.

(d) *Fossils at East Cornwall.* The fossils identified here by Billings show the Trenton limestone. But this is also on the course of the great slate range, and seems to be affected by some irregularity similar to that at West Rutland, since the strata all dip eastward, and are represented to pass below the quartzyte. The fossils in Shoreham, West Cornwall and Orwell, reported by Mr. Wing, while probably showing the Trenton limestone, are too remote from the marble belt to be considered, in this inquiry, as affording any demonstration, one way or the other.

(e) According to Mr. Wing's observations, the limestone containing Trenton fossils along the east side of the slate belt in the Otter creek valley, continuing northward from West Rutland, passes in an unbroken area in the northern part of Sudbury, round the northern end of the slate belt and unites with a similar limestone on the western side, and thence passes southward through western Weybridge and Cornwall, having slates above it which he refers to Hudson River slates. Whether this be correct or not, (and we have no disposition to question it) the eastern belt of marble continues uninterruptedly in a belt further east, and wholly on the east side of Otter creek, and runs further north, into Monkton, forming an independent northward prong, like that of a separate formation, accompanied all the way by the belt of iron ores, as represented on the geological map of the Vermont survey.* The synclinal therefore, that is described here by Wing and by Dana, may consist of the Trenton, overlain by the Hudson River slates, but that will require a correction of the late map of Mr. Walcott, for he has colored these slates as of the Georgia (Olenellus) formation.** At any rate, so long as Mr. Walcott differs from Mr. Wing in the interpretation of this supposed synclinal, Mr. Wing's reasoning and his observations cannot be taken as demonstrating the identity of the two limestones, which is the only point we wish to make at this place.

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*It probably runs below the red sandrock in Monkton, while the other limestone terminates in a flattened synclinal by the rising of the red sandrock underneath it in the same town.

**See his map, Vol. xxxv, 346, Am. Jour. Sci.

Fossils in New Haven. So far as these are determined they d on very imperfect specimens, and as they are in beds that lie some quartzyte, and which appear to be of the Winooski e series (Dana) they do not have any affirmative bearing on istence of the Trenton limestone.

*Fossils discovered by Mr. Walcott.** So far as the new local- f Trenton fossils, lately brought to light by Mr. Walcott, bearing on this question, they are those which are nearest the n marble belt, viz.: those on Mt. Anthony and those in Pownal. se fossils discovered in Pownal are taken to be from the bridge limestone, or from the "eastern belt" of limestone; they concur in testimony with those from farther north on stern side of the Taconic range, Mr. Walcott makes the un- ied affirmation (A. A. A. S., 1887, 213) that the Stockbridge one is of Trenton age. We cannot accept the inference, be- we find reason to believe the Stockbridge limestone is not represented. Any one examining Mr. Walcott's map will see here is at that point an abrupt jog to the eastward in all the

(h) *Fossils discovered farther south.* Some of the limestones farther south are proven by fossils to belong to the primordial, and some to the Trenton-Hudson terrane. But only on very general considerations could either of these be claimed to be the representative of the Stockbridge limestone. So far as this evidence goes it demonstrates the existence in Dutchess county of a limestone on about the same geological horizon as the Winooski limestone, and also on the same horizon as the West Rutland limestone, and it leaves us to infer that both of these limestones continue in the line of strike between those points.

2. *Facts that indicate the presence of two limestones.* If we seek for the positive facts that go to show that there is another limestone horizon, much lower than the Trenton, running through western Vermont and southward, we get the first evidence (independently of Hitchcock and Emmons) again from Mr. Wing, and secondly from the stratigraphic descriptions of Prof. Dana.

(a) *Facts from Mr. Wing.* It should be borne in mind that by the discovery of fossils in the quartzyte Mr. Walcott has demonstrated that it belongs in what he called middle Cambrian (Olenellus zone), but which he has later ascertained to be the lowest of the sub-faunas of the "Cambrian."* Therefore, there must intervene between it and the Trenton, not only the Winooski limestone, but the great Georgia formation, an interval that measures in Vermont at least 15,000 feet of sediments.

We find that Mr. Wing describes the quartzyte as *interstratified with the overlying limestone.* This he does not once, nor twice, but commonly, and wherever he speaks of the contact of the two terranes.** This is clearly brought out by his diagrams, and particularly by that giving a section from East Shoreham on the west to Leicester on the east. Whatever may be the errors of stratigraphy farther west, which might be demonstrated respecting this diagram, there can be no question about so simple a point as the interstratification of a limestone with a sandstone, which is represented as occurring near lake Dunmore in Leicester. It was near this place (lake Dunmore) that Mr. Walcott found primordial fossils in this quartzyte. There could be no stronger evidence not only that these two are of one age (and not one primordial and ıer Trenton), but that they both belong in the primordial

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*Position of the Olenellus fauna in North America, Am. Jour. Sci. xxxvii. 374.

**Am. Jour. Sci. xii. 340, 407, 414.

Facts from Prof. Dana. Some of the localities described
Wing were visited by Prof. Dana,* who has given his own
mmatic sections of the relations of the limestone to the
yte, and has shown the same interstratification. Some such
s were made in New Haven and in Monkton; and his con-
is to the effect that the Eolian limestone** includes "even
ones and dolomites of the red sandrock series"—i. e., may
limestones belonging in the Olenellus zone.
We might mention here the fact that an "Olenellus lime-
has recently been described by Prof. Dwight, in Dutchess
, N. Y., overlying an "Olenellus quartzyte" (Am. Jour.
xiv, 30); and that it occupies the area which Prof. Dana had
l on his map as Trenton-Chazy-Calciferous. This only in-
ally bears on the question of the extension of a primordial
one from central Vermont to Dutchess county.
h this we think we have shown the interesting fact that there
imordial limestone in western Vermont, the probable equiva-
the Stockbridge limestone, and that to it belong the numer-

THE STRUCTURE, CLASSIFICATION, AND ARRANGEMENT OF AMERICAN PALÆOZOIC CRINOIDS INTO FAMILIES.

By S. A. Miller, Cincinnati.

There have been described from North American palæozoic rocks, 1,100 species of crinoids, which are referred to about 110 genera. The arrangement of these genera into families, based upon uniform and consistent rules, is the object of this article.

When I published my work on North American Geology and Palæontology, I proposed a few new family names, but, as my object then was to present the state of the science as it existed, and not to write an original treatise on any one branch, I generally followed the classification of others, and, as they were not in accord as to family characters, the families, as there given, are not of equal value. The new family names which I proposed were not defined and hence were used only provisionally, and because I could not refer the genera to families that had been limited and defined. Indeed, I did not have the time to properly classify the genera into families, nor access to the fossils for the purpose of verifying such classification if I had taken the time from other duties. Since that work was done, I have had an opportunity to inspect a large lot of crinoids from Mr. Gurley's collection in addition to those in my own cabinet, and to review the various systems of classification in use in this country, and now propose to present my views of family classification.

I would desire to state, in the first place, that, in many instances, I do not agree with the views of Wachsmuth and Springer, as to family characters and the classificatory value of the structural parts of crinoids, and while I may refer the same genera to some families that they do, yet the reasons therefor are not the same. I believe families should be established upon the structure of the calyx, and, for this purpose, the number of the basal plates is first in importance; second in importance is the presence or absence of subradials; third the presence or absence of regular interradials, and, after this, comes the structure of the azygous side and other parts. For the purpose of showing how radically we differ, I will quote a few sentences from their work on the Palæocrinoidea.

subdivision according to the number of basal plates may
ate elementary studies, but it is certainly not a natural
fication."

n the first part of this work we have discussed somewhat
the relations of the underbasals which we took to be the
ct of growth in geological time, introduced gradually by
olation between the basals. It is very remarkable that al-
h the introduction of underbasals dates back to the Lower
an, as a rule the genera in which those plates are found differ
time materially from those in which they are wanting."

have in the introduction to this work, page 17, dwelt at
length upon the basals or first ring of plates below the
s; and believe we have shown that the basal disk, whether
sed of one, two, three, four or five pieces can almost inva-
be reduced to five elementary pieces, and that all devia-
from this number have been produced by anchylosis of two
e of the original segments. This of itself is a strong argu-
against a classification based upon the number of these

been observed, and moreover the construction is such, that no additional pinnulæ could have existed ; while on the other hand, no covering has ever been discovered in forms with true pinnulæ."

After I described the plates covering the ambulacral grooves, in Glyptocrinus, notwithstanding the long flowing pinnules, I believe they modified their views, but, at present, I have no reference to the revised opinion. Their greatest mistakes seem to me to have arisen, however, from the use of the mongrel word "*underbasals*," and a complete misconception of the purposes subserved, in the animal economy, by the plates referred to, and the consequent neglect to give the basal plates the examination their importance demanded. They frequently discuss "rudimentary underbasals," when no such thing was ever found in a palæozoic crinoid, and from the structure of the calyx, and purposes subserved by the basal plates, "rudimentary underbasals" never could have had an existence in any of them. For instance, they say on page 7, 2d part, "Glyptocrinus was originally described with five basals and no underbasals. Hall afterward discovered in G. decadactylus, small pieces concealed in the basal cavity, so rudimentary, however, that both he and Meek hesitated to call them basals, although both authors apply that term to the proximal plates in all other cases. Meek distinguished them as "subbasals." We have examined the plates in question very carefully in the species named, and find them, although very rudimentary, placed within the basal ring; hence they are according to our terminology, true underbasals, and not as Hall describes them a 'quinquepartite' upper joint of the column;" and again, on page 186, 2d part, "Glyptocrinus differs from Glyptaster in having rudimentary instead of moderately developed underbasals." After I had shown that there were no such plates in Glyptocrinus, they admitted on page 102, 3d part, that the absence of underbasals in this genus "is clearly proved."

They said of Heterocrinus in the first part of Palæocrinoidea : "The absence of underbasals in some of the species is a good illustration of our views that the underbasals do not constitute elements in the structure of the Palæocrinoidea, but are merely the result of growth in geological time." Again they say: "Underbasals, minute, in some species almost undeveloped, and appearing externally as subtrigonal points at the lower end of the sutures between the basals ; in some species apparently wanting ly." But in the third part they state correctly that there underbasals in Heterocrinus, and having studied the belonging to the Heterocrinidæ, they defined them as yclic. It will be readily seen that where such crude and ous notions exist about the principal plates of a crinoid, e same plates bear two different names, the family classifica- ust be imperfect, and governed by the whims of the various s.

Herbert Carpenter had an opportunity of studying some liv- inoids, after which, in his abuse of Dr. Hambach, of St. he reasoned, through that conduit of English ignorance nceit, "The Annals and Magazine of Natural History," as s :

have the strongest conviction that the would-be interpreter inct fossil forms starts at a very serious disadvantage, if he ot commence by obtaining the best possible information the morphology of their nearest living representatives. have done.) In order to understand, even with an approx- degree of correctness, extinct groups, such as the blastoids former, while there are two in the latter, and other important structural differences, and he at once proceeded to redefine the latter genus so as to include the former. Speaking of Xenocrinus, he said "I cannot help suspecting that a better knowledge of this type (Xenocrinus) will lead to its absorption into Retiocrinus." He said, "Hybocrinus is a crinoid of very embryonic type. The relatively large size of the basals and the retention of the anal plate, together with the simplicity of its arms, and the absence of pinnules, all indicate its low stage of organization." He regarded Bærocrinus "as a permanent larval form, which has only developed three of its five arms," and Haplocrinus is a "persistent larval form." Wetherby illustrated and described the upper azygous plate of Hybocrinus as "rounded and crenulated at its distal extremity as well as much thickened;" this the doughty Carpenter disposed of by saying he had received a specimen from Mr. Wachsmuth on which he could "make out little or no trace of crenulation."

It would not be necessary to point out his illiteracy, for he even uses capital letters for specific names, or lower case as it may happen, showing his want of a common knowledge of grammar, and recklessness in the symmetry of nomenclature, were it not for the fact that a mutual admiration society sprang up between him and Wachsmuth, and Wachsmuth adopted many of his blunders and republished them, thus giving currency to them throughout the country and injuring the progress of knowledge. It is true that Wachsmuth has refuted some of his vagaries and unwarranted conclusions, but he adheres to many of his innovations in nomenclature, though unwilling to go so far as to call all the regular interradial and vault plates oral plates and all the azygous plates anals.

The basal plates of a crinoid rest directly upon the column and are truncated by the columnar canal, around which the animal was attached by ligaments, the scars of which are very frequently preserved. The subradial plates are never basals nor are they in any sense homologous with the basals. In 1879, P. Herbert Carpenter disregarding the original definition and illustration of Heterocrinus by Hall, and the equally plain illustration and positive statement of Billings, that there were no subradial plates in the genus, or not having the sense to understand an illustration and definition, asserted there are subradials in Heterocrinus

oposed to call the subradials, which had no existence, the
l" plates because he said they were the genital plates, and
als he proposed to call the "*underbasals*" a mongrel word,
nglish and part Latin. This was a case of pure ignorance,
tion and conceit. Only one overgrown with self-conceit
propose to change the nomenclature in any branch of Nat-
istory, where no change is demanded in the interest of
, and only the most illiterate would propose in science a
l word formed from two languages, and only the most
t would select for the application of a new term, an object
has no existence in nature whatever. The assertion that
radial plates in any palæozoic crinoid are genital plates is
gratuitous, and not warranted by any of the known facts
to crinoids. It would have been equally as correct if he
erted that the subradial plates were the seat of the soul,
might have fortified the assertion by claiming that he had
e blue ethereal substance floating around them. We were
ed however that he coined the word from English and Latin
ffects profound learning in the German, and like the poli-
namoured during a campaign of the "sweet German ac-

confusion to the definition of crinoids; but it is to be hoped that each one does not constitute "most of the leading writers on crinoids," in this country. And it is high time American palæontologists would cease to look to England for information, where less is known of its own fossil crinoids, than happens to the lot of any other country, in which there is any pretension to palæontological knowledge, and where more shallow pretenders vent their stupid hypotheses as to the fossil tests of these animals than exist in any other land.

Prof. D. S. Jordan in "Science Sketches," very appropriately says: "The chief aim of the law of priority, like that of the law of primogeniture, is not the survival of the fittest, nor yet justice, but *simply fixity*;" and the application of this rule should prevent the most destructive innovator from interfering with the long established names of the plates in the calyx of a crinoid; besides there can be no more appropriate and truthful names than "basals" and "subradials." Subradial plates occupy a subradial position, they are neither radial nor interradial but one half is below one radial series and the other half is below another radial series. Basals are always basals and never "underbasals." In some genera they are below the subradials, but in other genera the subradials extend below the basals, while the basals, in the interior of the calyx, project higher than the subradials.

There are no anal plates below the arms in the calyx of any palæozoic crinoid, and there is no more reason for calling the plates in one interradial area anals, in the present state of learning, than there is for calling them orals. The word "azygous" is applied to them because it is noncommittal, and simply indicates that the plates are not the same as those in the other interradial areas. The opening in the azygous side of the vault or in the proboscis, may be an anal opening, and, if so, the plates surrounding it or covering it might be called anal plates, but the name cannot be applied properly to any other plates of the body. The course of evolution was progressive toward more complicated structures, in crinoids, until the Subcarboniferous age; here they seem to have attained their most perfect existence. The living crinoids are the remnants, probably, of a long line of retrogression, the degenerate descendants of more highly organized ancestors—wherein some of their parts are of comparatively modern origin, and others, which the ancestors possessed in a high degree, holly departed, so that not even a rudimentary plate or scar to indicate the functions once exercised. Where progression n the rule, in the development of any class of animals, look to the embryology and the growth of the young for d light on the fossil remains of past ages, but where the on has been backward, for geological cycles of time, the of embryology of the degenerate descendants, sheds but ight, if any, on the primitive ancestry. To speak of a rinoid as a "permanent larval form" or as an "embryonic is, therefore, unenlightened affectation.

basals, in all palæozoic crinoids, were the first plates to fully developed, and, after this, they retained the same n, respecting the column, through all further stages of the of the animal, as is shown by the uniform projection of the isk beyond the column, in all specimens, large and small, same species. It is the practice in describing the form of al plates to ignore the side truncated by the columnar and treat the plates, in description, as if they came to a t the center of the columnar canal, which of course is never , and to illustrate them by cutting off the lower end so that the basal plates. There is an external circular depression into which the end of the column was inserted, and this depression is surrounded by a rim to afford further strength to the point of union between the column and the body of the crinoid. At least three plates of the column were inserted in this circular depression, one of which had an extended rim beyond the column that filled a circular furrow on the interior of this depression which locked the column in the basal plates. The first plate of the column at the base of this circular depression is thin and radiately ridged to interlock with the second plate. The rays of the opening on the internal side of these plates are flanged so as to enlarge the end of the columnar canal as it passes through the basal plates; this enlarged opening is surrounded by a rim for some kind of muscular attachment and to give strength to this part of the calyx. On the outside of this rim there are radiating ligamental furrows or vascular markings for the attachment of the animal sarcode. These characters are well shown by the illustrations. The basal plates of Eupachycrinus magister are also illustrated, showing the conical elevation in the interior of the calyx pierced at the summit by a five-rayed opening for the columnar canal, with the rounded ends of the rays truncating the plates. The pentagonal opening is surrounded with ligamental scars or radiating ligamental lines while the other parts of the internal sides of the plates are smooth. I have seen the same evidence in the basal plates of Delocrinus. I have the basal plates of a Glyptocrinus showing the thickening of the plates internally around the five-rayed canal and bearing evidence of ligamental atttachment. It is well known that the end of the column, in all palæozoic crinoids, is so firmly attached to the basal plates, that it is rare to find a good specimen where the column has been separated from the basals, leaving the place of the columnar attachment in a good state of preservation. I have before me a Batocrinus, with a hemispherical depression at the base, which is radiately furrowed surrounding the pentagonal opening for the columnar canal, for the firmer attachment of the column; and a Poteriocrinus furrowed in like manner for the attachment of the column, and showing a rim on the basal plates surrounding the point of attachment. I have a specimen of Anomalocrinus showing the anchylosis of the upper joints of the column and of the column with the basals, and after examining specimens in different

, I have concluded it is not uncommon for the plates of the
n, at the upper end, to be anchylosed together. The only
ntal scars in the calyx of any crinoid thus far discovered
nd the columnar canal. It follows therefore that the basal
are the most important in classification of any of the plates
calyx, because the animal was attached to them, while the
plates subserved the inferior purpose of simply enclosing
ner parts of the animal sarcode.

ust be apparent, therefore, that there can be no rudimentary
none that are developed from the upper stem-joint and
xcept they are large enough to surround the columnar canal
th area enough for the muscular attachment. The anchy-
f the basal plates is as common in genera having no sub-
as it is in those having them. It would appear, that the
nent of the column to the basal plates, the passage of the
ar canal through them, and ligamental attachment on the
, held the basal plates firmly in one position, and while,
ir younger state, they were capable of growing and con-

visceral cavity surrounding the area of ligamental attachment to the test. In some genera they cover half the calyx below the arms, and in all cases they materially affect the form and structure of the calyx and body of the crinoid. Where the plates are large, they were supported in position by ligaments in beveled sutures, as in Eupachycrinus, or by peculiar denticulated or serrated edges such as occur in Poteriocrinus and in Arthracantha, as illustrated and defined by Hinde, or in Ulocrinus as figured and described by myself and Gurley. For the purposes of classification, therefore, no family should include genera having subradials and those in which they do not exist.

The next family character will be found in the presence or absence of regular interradial plates. These plates allow breadth to the body, and though, in their extension over the vault and in other respects, they may sometimes sink to generic or specific importance, yet the fact of their presence or absence is always of family value. The position of the first interradial is of high classificatory value, and genera supporting the first interradials on the basal plates are never to be associated in the same family with those supporting the first plate between the upper sloping sides of the first radials.

The next in family importance are the azygous plates. The structure in this part of the body is frequently complicated and is always of generic importance and frequently of family value. For instance, a genus having an azygous plate resting on the basals is not generally, to be classed in the same family with one having the azygous plate truncating a subradial, for the whole structure of the azygous sides of the genera is different in these cases, commencing with the position of the first plate.

I regard each plate, in the calyx of a crinoid, to which I have attached family importance, as an independent morphological element, and, except in the specimen figured from my collection in Ohio Palæontology, by Meek, under the name of Anomalocrinus incurrus, where there occurs an extra basal plate below the termination of a suture dividing a radial, I have always found the plates the same in each genus.

The structure of the arms, I think, is never of family importance, and above the brachials never of generic importance, though always of specific value. An illustration or two will suffice for the demonstration of this opinion. In Dichocrinus

e a species with small subquadrangular pieces forming sim-
ns, another with arms composed of rather large cuneiform
and another with arms composed of the double series of
cking plates. In Poteriocrinus, the species have arms
g in number from ten to fifty, and the structure of the
aries almost as much as their number does.

shape of the column is probably of generic value. The
nd proboscis have characters of family value but they are
le understood to base any general classification upon them.
here they have been investigated, they afford additional
ce in support of the families established on the structure of
yx as herein above indicated.

[TO BE CONTINUED.]

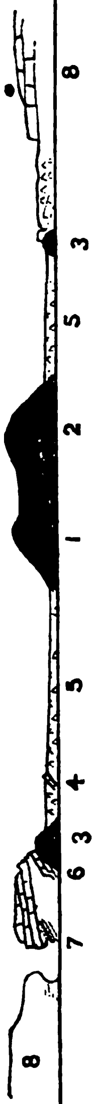
T KNOB: A MARINE CRETACEOUS VOLCANO.

By Robt. T. Hill, Austin, Texas.

WITH NOTES ON ITS PETROGRAPHY.

By J. F. Kemp, Ithaca, N. Y.

accompanying maps and figures, with my previous article



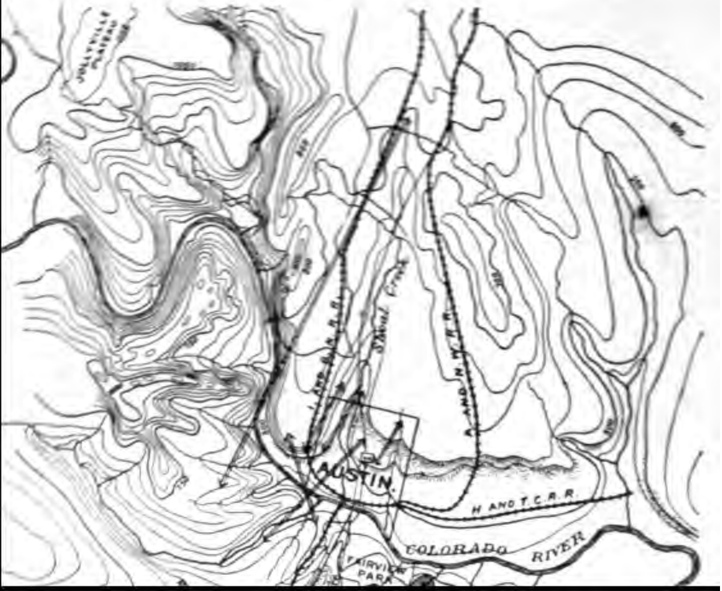
seen in the cross section (Fig. 2, and the map). The hills have an altitude of 750 feet above sea level and 50 above above the surrounding prairie.

They are composed of a hard black rock, the exact lithologic constitution of which, as shown by Prof. Kemp in the accompanying article, is that of limburgite or nepheline basalt. The basalt has an imperfect columnar structure nearly vertical at the south extremity of the hill, (Fig. 2, 1 and 2 of the section) and nearly horizontal at the north side. The flat region between the basaltic hills and the chalky perimeter of the igneous area is filled with a soft yellow amygdaloidal exfoliating material some of which is undoubtedly the product of basaltic decomposition, while in other places it resembles volcanic ash. The exfoliations are perfect and resemble the illustration of that structure given by Geikie.

Proceeding in any direction from the basaltic hills which form the center of the whole outcrop the average distance to its edge is about one half mile, where excellent contacts with the chalk are found. The chalky stratum forming the margin of this area throughout its whole extent is crenulated into gently waving undulations and presents different aspects of hardness. In places of direct contact with basaltic material the chalk is converted into hard marble; where the ash-like material intervenes between the basalt and chalk the latter retains its soft unaltered pulverulent nature (Fig. 2).

The induration of the chalky sheet away from the central hills and its metamorphism are clearly indicative of activity after the deposition of the chalk and would be a sufficient reason for making its period later than the age of the Austin chalk, were it not for other evidences found within a radius of ten miles. Proceeding in any direction instructive outcrops are found. One mile north (at C on map) Onion creek has cut its way through a great archway of this hardened chalk to a bed of ancient debris which must have been deposited by an eruption previous to the event that marmarosed the chalk.

This cañon of Onion creek is from fifty to one hundred feet deep and is formed by undermining erosion (Figs. 1 and 3).


JOLLYVILLE PLATEAU
Shoal Creek
I. AND G.N.R.R.
A. AND N.W.R.R.
AUSTIN.
H AND T.C.R.R.
COLORADO RIVER
FAIRVIEW PARK

Inocerami (*I. umbonatus?*), the characteristic Inoceramus of the Austin chalk; showing that this preservation of fossil remains was by falling debris in their habitat.

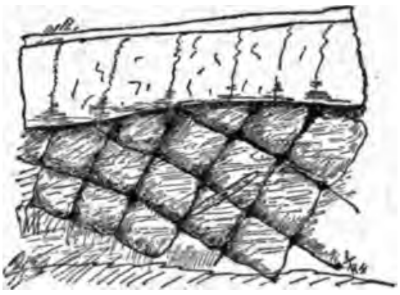


FIG. 1.—Contact of Chalk and Igneous Matter, with Limestone inclusion.

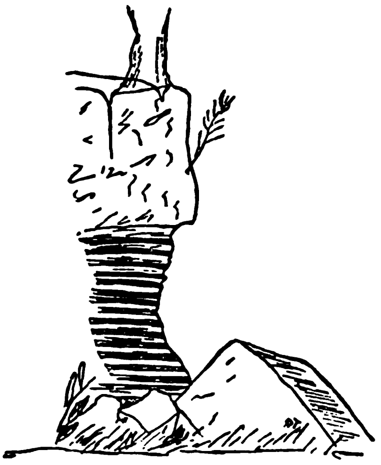


FIG. 3.—Alternations of Igneous Strata, with Fossiliferous Chalk.

The ashy layers are from one to six inches thick and alternate with layers of similar thickness of chalky but laminated material, showing there were alternations of deposition of volcanic ejecta in a molluscan inhabited ocean. Furthermore, as the species and chalk are deep water deposits, a rapid shallowing is inferred and as there is an absence of land debris and littoral fossils, the shallowing must have been insular and not continental. Hypothetically, this oldest record of Pilot Knob shows a rapid elevation of the ocean's bottom with its life from chalky depths to land, accompanied by many deposits of volcanic debris.

knobs were probably the center of disturbance and the
hills of to-day represent the neck of an ancient volcano
rater has long since been denuded. Proof of this hypoth-
he increasing occurrence of debris as we recede from the
or four or five miles around. As shown on the map at E,
nd H, the ash is found in greatest abundance towards
t and north. At Kunz station, four miles south of Aus-
ilroad cut gives a fine exposure of this volcanic debris in
ntact with unmetamorphosed chalk. It is a yellow and
loose material, hardening on exposure, and contains occa-
ombs of limestone (metamorphosed chalk) from a pea to a
diameter. About twenty feet of ash are here exposed
bank is cut in two by a great fault which will be ex-
. Other beds of debris occur two miles west of Manchacha
in Bouldin's creek, and in Fairview Park, South Austin.
exposures are made by the denudation of the Cretaceous
which covered them after their deposition. Superficial de-
ition and the formation of zeolites followed.

mpanying the exposures of debris are occasional strata of
or black-yellow crystalline limestones full of the fossils of

taceous, not Cretaceous, for the very latest Cretaceous strata are involved in their disturbance. These faults belong to the great Balcones system described by me in this journal, and whose line is followed by the I. & G. N. R. R. on map.

Tertiary and Quaternary History.—It is probable that the present topography of Pilot Knob and its crater-like weathering is the result of unequal resistance to atmospheric agencies and the whole area was once buried beneath Tertiary and Quaternary sediments. The original interior shore line of the stratigraphic features of Texas which are rapidly receding eastward is a question to be solved, but from the truncation of the dip planes and scarps of stratification, with the great thickness of the Neozoic terranes, it is evident that their former western margin except in rare instances was far west of its present position. Thus it was that both the great Cretaceous subsidences once covered the now denuded "Central Paleozoic region" of Texas, while the shore line of both Tertiary and Quaternary subsidences leveled the topographic features of Pilot Knob; for, several miles west of this extinct volcano, resting upon the western margin of the upper Cretaceous and against the Balcones scarp, as seen in Terrel hill on map, there is a distinctly preserved beach of the same post Cretaceous, probably post Tertiary, gravel which once covered Pilot Knob.

Relation to Other Areas.—Pilot Knob is but one of a score of igneous outcrops between Austin and the Rio Grande west of Eagle Pass, to which I have previously given the name of Shumard Knobs, but its exact relation to them has not yet been studied. It is in line with the igneous features of North Texas and southeast Arkansas. The general structural features indicate an affinity between them and suggests that together they constitute a line of igneous activity which once extended from the Ouachitas to the Rockies. It is interesting to note the proximity of this Cretaceous igneous outcrop to the Burnet granite. It is probable that this has been a region of intermittent activity since early Paleozoic time.

Conclusions.—From its structure it is shown that Pilot Knob is the neck of an ancient volcano which rose out of and deposited its debris in the deep water of the upper Cretaceous sea (probably Niobrara sub-epoch). From its isolated position remote from any contemporaneous shore line it must have been an island erup-

ilot Knob probably belongs to a great chain of igneous
s, eruptive and basaltic, extending from the mountains of
Mexico to the Ouachita system of Arkansas, both of
egions abound in related features. The great Balcones
f N. 20° E. faults of central Texas are later than upper
us. In late Cretaceous, Quaternary and Tertiary times
ob was either totally submerged or greatly denuded.

ES ON A NEPHELINE-BASALT FROM PILOT KNOB, TEXAS.

J. F. KEMP, Ithaca.

ction of specimens representing various parts of the out-
s forwarded for study. They are very dense, finely
ne, of a dark gray or black color and resemble the usual
mpact basalts. Small lustrous grains, 1.0 mm. and less,
scattered through the mass and are shown by the slides
vine crystals. Amygdaloidal portions are found on the
whose cavities are filled with calcite and probably by
s well.

ck is a difficult one to make transparent as the sections
merely translucent up to extreme thinness. It readily

basanite from Fortification peak, Col., and in several European rocks of related character. Comparison with slides of the latter in the writer's possession shows quite analogous phenomena.

In other specimens the sections consist principally of a felt of brown augite needles 0.2 mm. long by 0.05 mm. broad, with a dark glassy material filling the interstices. The rock seems in such cases to approximate the limburgytes and to resemble quite closely a slide from the Hasenberg in Bohemia. The augites which gather in ocellar groups or nests are scarcely larger than those just mentioned and have the same brown color. They are abundantly provided with inclusions of magnetite.

The olivine is idiomorphic and exhibits most frequently the cross section that would indicate an original form with $2 P \bar{\infty}$ strongly developed. A few included grains of magnetite are to be seen. Alteration is not usually far advanced. Where it seems to have reached its limit it affords a sphero-crystal of radiating needles, giving the usual interference cross. The dark grains scattered through the groundmass are all called magnetite above because they appeared in no case to be at all transparent and gave no indication of containing titanium. It cannot be stated therefore that either perofskite or chromite is present. An analysis yielded the following results from which it appears that the rock is very basic and of very high specific gravity:

SiO_2	38.35
Fe_2O_3	20.32
Al_2O_3	9.18
CaO	11.76
MgO	13.78
K_2O	2.02
Na_2O	2.77
Ignition	1.20
Total	99.38

Specific Gravity 3.211–3.223

The rock is therefore to be considered a nepheline-basalt. So far as is at present known, such or allied rocks are not abundant in the United States, notwithstanding the great development of basalts in the west. Zirkel[1] determined one from the Kawsoh mountains, Nev. and others from the Elkhead mountains, Col., both of which contain plagioclase. Analyses given in vol. ii, pp.

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[1] Survey of the 40th Parallel; vol. vi, p 256.

l 178 of the 40th Parallel Survey show them to con-
n 10 to 15 per cent. more silica. Dr. Oscar Leow[2] has
rmined a basalt with nepheline (nepheline-tephrite) from
ncillo mountains in Arizona, which like the others is far
idic. The Texas rock also diverges widely from the
; and basanites described from the Crazy mountains,
y J. E. Wolff[3] but it resembles closely so far as may be
rom the description, the nepheline-basalt collected by J.
ner in the Island of Fernando de Noronha and described
. Williams.[4]

Laboratory Cornell University.

ORTH-EASTERN EXTENSION OF THE IROQUOIS BEACH IN NEW YORK.

By Prof. J. W. Spencer, Atlanta.

arometer was used in the measurements of the Iroquois
rans. Roy. Soc. Can. 1889) in the region of Watertown,

The rise continues in a northeastward direction and, for the last forty miles (which were levelled) averages six feet per mile. Thus there is proved that no glacial dam existed in this part of the Adirondacks. Having traced the beach to an elevation of 972 feet above the sea, at a point south of Morrisburg (on the St. Lawrence), the measured warping is now sufficient to account for every foot of the rocky barrier across the basin of lake Ontario. This measured differential movement has been entirely since the episode of the upper till. This paper is intended only as a preliminary announcement, but the details will be eventually published.

THE RELATIONS OF THE STATE AND NATIONAL GEOLOGICAL SURVEYS TO EACH OTHER AND TO THE GEOLOGISTS OF THE COUNTRY.[*]

JOHN C. BRANNER, Little Rock, Ark.

The geologists of the country may be classified as follows:

I. Professional geologists, connected with the United States Geological Survey or with some of the state surveys.

II. Professorial geologists, or those teaching geology in our colleges and universities and sometimes making excursions into the field, either in the course of instruction or in order to carry on original investigations.

III. Consulting geologists, or those doing private economic work.

IV. Amateur geologists, including students who do volunteer work.

It is of the relations that exist, or should exist, between our national survey, the state surveys and the geologists of the country, in whichever of these classes they may fall, that I propose briefly to address you.

Investigations are often undertaken largely in the course of instruction carried on in college laboratories, but it is rarely that individuals or institutions other than the state and national surveys have undertaken extensive and expensive geologic operations. We must except, of course, in this statement those of an economic nature.

The reason of this is that individuals seldom, and commercial organizations never, devote their means to purely scientific investigations; and inasmuch as these investigations require large sums of money, and as they are conducted largely with a view to increasing human knowledge the expense of them must be borne by the public treasury.

With our official organizations most of the working geologists of the country, excepting those called consulting geologists, are connected

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[*] Vice-presidential address before Section E, American Association for the Advancement of Science, Indianapolis, Aug. 20, 1890.

as salaried assistants, permanent or temporary, or as volunteers.
ese organizations carry on their work independent of each other,
without any regard to one another's existence, while individual
igators go each his own way pretty much as if he had the whole
of geology to himself.

ne has cause to be surprised at this lack of concerted action
men working upon the same and similar problems in the same
y, we must remember that this state of affairs is the outcome
of our democratic institutions and of our disposition to let every
ift for himself, partly of the great size of the country, and partly
fact that there has never been, until recently at least, any at-
or even any disposition, to bring all the geological material in
untry into harmonious action and relations.

have done better in this respect of late years, but there is still
room for improvement. If there has been but little coöperation
to among geologists and between official surveys, doubtless it is
se, as Professor Brice says of democracy, "It takes many cen-
to form those habits of compromise, that love of order, and that
t for public opinion which makes" good geologic work possible.

United States Geological Survey.—The early geologic work carried
the government in this country was done by military exploration
s under the War Department. Geology was in no case the prime
of these explorations, work of this kind being done by geological
és of the parties. Geology came to be a more and more important

practicable a plan for surveying and mapping the Territories of the United States on such general system as will, in their judgment, secure the best results at the least possible cost."

This committee of the National Academy of Science was appointed and made the required report. It recommended that the surveys then in existence should be discontinued, including the Land Office surveys, and that there should be a single national geological survey which should deal with geologic problems, and that all mensuration should be done by and under the Coast and Geodetic Survey, which should furnish whatever maps might be wanted.

The action suggested regarding the Coast and Geodetic Survey was not taken, but Congress discontinued the old geographical and geological surveys and the United States Geological Survey was established in 1879 as a permanent bureau of the Department of the Interior.

In the reorganization of the national survey after the extinction of the old surveys most of the men from all the former institutions were retained. This is where we find ourselves to-day with our United States Geological Survey.

It is not necessary that I should speak of the functions of this national survey as defined by law, for in a general way you are all familiar with them, while the business organization and general plan of carrying on its work is set forth in the eighth Annual Report of the Director. Practically it has *carte blanche* to carry on geologic investigations over the whole territory of the United States, and in every branch of scientific work directly related to geology, such as geography, topography, paleontology, physics, chemistry and statistics.

Now over this same area, though limited to the states carrying them on, we have our several state geological surveys; while private individuals, educational institutions, scientific societies and commercial corporations are at liberty to carry on such investigations as they see fit, and all regardless of each other.

It would be very natural to expect that there would be more or less serious conflict between organizations and individuals working, as these do, upon the same questions and over the same areas.

In the earlier work carried on by the federal government, however, the various territories were the specified areas to which the national surveys were confined, and now that the whole area of the United States is open to this work, a broad-minded and coöperative direction seeks to aid and strengthen the state organizations instead of antagonizing or annihilating them.

But I wish to emphasize the fact that the classification of the geologists of the country, the work within the domain of the national survey, the work within the domain of the state surveys and that which can be, or will be, accomplished by private institutions, corporations or individuals demand that there should be some more definite or better organized coöperation or coördination in all this work and among all these men.

The success of commercial and industrial enterprises the world over has been due to a greater or less extent to concerted action. In educa-

natters where action has been concerted and efforts and means
trated there have our most marked successes been. Geologists
sregard the advantages to be derived from such coöperation, but
be at their own expense and at the expense of the science.

without doubt one of the reasons that coöperation has not been
practiced than it has been is that a sort of antagonism between
rganizations has been handed down to us, and also because it
ime to bring into harmonious action a large number of men scat-
ver a vast territory and variously interested in widely different
of geologic problems.

statement has been made that the United States Survey does co-
with very nearly every state survey in the country, but the fact
the national survey does not know what the state surveys are
xcept in a very general way, and that the state surveys know but
nothing of what the national survey is doing, except perhaps as
happen to be picked up in private conversations and in private
ondence between personal friends.

e bear in mind that this is not intended as reflecting upon the
r of the United States Survey; coöperation can only exist by
nmon consent of all the parties concerned, and it is quite as much
lt of the state surveys that there is no such coöperation as it is
the United States Survey.

ht cite the case of a state survey of which I have some knowl-
here the national survey carried its topographic work forward

towards official relations and toward legislation. For these are not matters to be fixed by laws; laws would interfere with that freedom of movement that gives health, vigor and activity to our scientific bodies and to our scientific men; they can only be determined by common consent and by usage.

To begin with there should be some unanimity among all geologists about the scientific standing of our government and our state surveys, and about what each one can do and ought to do.

First in regard to the United States Geological Survey:

This institution stands at the official head of all our surveys and of all our geological work.

Every statesman recognizes the fact that science is an element of prosperity and power which it is the duty of the state to foster just as it should foster other elements of progress and civilization, and it should fill every geologist with the profoundest gratification that our statesmen realize the importance of the general government's giving liberal support to geologic work.

We must all of a necessity take a deep interest in the organization and conduct of this, our national survey, for the work to which it is devoted can only be done by aid of the government, and should that aid fail, either on account of proper organization or inefficiency, or on account of jealousy, or for any other reason, the progress of the science of geology in this country would be seriously impeded if it did not come to a dead halt.

We have reason also to congratulate ourselves and to congratulate the country that since its reorganization in 1879 there has been in the directorship a geologist in sympathy with all branches of scientific work, and at the same time a man who does not shirk his duty in the survey's relations to Congress.

Not a few scientific men have false notions of their personal and professional dignity when these affairs crowd upon their attention.

We need only remind ourselves that appropriations are quite as essential to geologic work as workers are, and that this part of the business can no more be neglected than any other part of it.

Just think where we should have been if no efforts had been made to lay the truth before legislators. Congressmen are busy men, too busy to go out of their way to look up worthy institutions that need support. All that enlightened statesmen want to know are the needs, demands and uses of these surveys, and they will see that they are properly supported; but how are statesmen to get this information if some well-posted geologist doesn't furnish it? Statesmen must depend on geologists for such information as will enable them to act intelligently, and it is as plainly the duty of the director of the United States Survey to inform Congressmen and Senators of the needs of geologic work in the country as it is to carry on the work itself. It is a duty he owes to the people and to science.

National work encourages and stimulates state work, and state work

n favor of national work, and both stimulate private enterprise
'estigation. The return from all this no man can measure, for
th material and intellectual, and in both these senses it is felt
y nook and corner of the land.

national survey is thus doing a work that no other institution
and it is able to maintain an organization of geologists that no
nstitution could maintain. For nowhere, in no country, is there,
no time has there been, a corps of working geologists superior to
our present national survey—a body of geologists, of which every
ic man and indeed every citizen of this country may well be

ng no connection with that organization, either present or pro-
e, I feel at liberty to express a frank, disinterested and indepen-
ıdgment.

I take the liberty to express the conviction just here that no
mazing thing can be found in the annals of science than that
re geologists—men who claim to be interested in the advance-
f science—who would be glad to put an end to our national
the institution that has, as it were, laid the golden eggs of geo-
ience in this country.

Vational Survey and the State Surveys.—With this splendid equip-
f men and of means, what can the National Survey best do and
ve to state surveys and to private enterprise? The question is
ed as implying that the officers of that body are not perfectly

those investigations requiring much time and labor and money and many specialists. The reasons why state surveys cannot do work of this class are not far to seek: The men with whom the national survey has to deal are our broadest-minded statesmen—men who comprehend the scope and importance of purely scientific work, while, as a rule, state legislators look to immediate, and what they call practical, results. Such men cannot be convinced of the importance of any work that looks not to the immediate material prosperity of the state, while they are but little concerned, as a rule, with the intellectual income from it.

It is entirely beyond the means of any state survey to make a topographic map of the entire area of the state: the best it can do is to select a few typical areas and map those. But maps are absolutely essential to satisfactory geological work, and map-making has come to consume a constantly increasing share of the money appropriated for geological surveys, both state and national. The national survey, however, having large appropriations for topographic work, and contemplating as it does the mapping of the entire area of the United States, ought to do this work.

That these maps must meet various demands and must therefore be constructed with varying degrees of accuracy and detail every one will admit. As a matter of fact, however, the maps made are usually, as they should be, parts of a plan, and upon a scale, for mapping the whole of the United States. This plan and scale may be perfect for that particular purpose, but it often happens that neither the plan nor the map is adapted to the purposes of the state surveys. And certainly nothing can be plainer than that the maps made by a geological survey ought to be available for geological work, or that, failing to meet the demands of geology, there is no geological excuse or reason for their existence.

Take for example the topography of the glaciated area of the Mississippi valley. The region is one of but little relief, and, in order to bring out this relief, the contour intervals must be very small. But the contour interval on the U. S. Survey maps is 50′, one that completely ignores the delicate topographic character of the glaciated area of the Mississippi valley.

It follows therefore that the plan for topographic maps should be sufficiently flexible to meet the demands of those by whom and the purposes for which they are to be used.

Geodetic work cannot be carried on by the states because states are but small parts of, and furnish but a few points in, geodetic questions. European countries have even been obliged to unify their work. In the United States work of this character must be left to some institution of the general government.

That paleontologic work should be relegated to the national survey seems to me scarcely to admit of question. The reasons for such assignment are briefly as follows:

1. It is a piece of purely scientific investigation, the importance of which state Legislatures as a rule do not comprehend.

e investigation demands a knowledge of the fossil fauna of not
alone, but of a great many states, and often of the fauna of all
red rocks of the earth, while the observations limited to a single
sure to lead to duplication and to erroneous conclusions.

he work can be properly done only by specialists which state
annot afford to employ.

he illustrations necessary in a paleontologic report are too ex-
be paid for out of the modest appropriations made for state

t be urged against these reasons that the states of Illinois and
afford striking examples of the fact that states may and can
rry on a high grade of paleontologic work. But it should be
ed that the conditions under which these excellent results
obtained have passed or are about to pass away. For while
of Illinois and New York have grown in wealth and intelli-
e their surveys were begun, the legislatures of those states
to-day be induced to take up and carry forward works of so
scientific nature, and if those states could have seen the end
beginning, it may well be doubted whether they would have
n the great paleontologic investigations carried on so long and
sfully by Hall and by Worthen.

r point which I must insist upon is, that it is the place of a
ogical survey to do what is wanted in the state, and as a rule
results are wanted. The people are entitled to what they pay

logic work may give preference or prominence to one or to the other phase of the question as the case may demand.

Some geologic problems naturally precede others, and if we work intelligently, we must take up these problems in their logical order. But in state work this is seldom possible, for state geologists must do their work in an order made necessary, not by geology alone, but by some economic consideration it may be.

I have said that economic problems should, in so far as possible, be left to the states. There are cases, however, in which this cannot be done, for there are often those which, requiring study over a wider area, cannot be solved in a single state. These should be studied in part or entirely as the case may demand, by the national survey. Take for example the lead ores of the country; these ores occur in several states, and in each case it may be under somewhat different circumstances. Now the study of the origin and distribution of lead ores should be taken up as a whole, and not simply as a local question, for it cannot be satisfactorily studied and discussed in any single place.

If geology is studied as it should be the student must be at liberty to move about as the exigencies of his work demand. This is not permitted by state surveys, and even if the employees of a state survey felt themselves at liberty to travel over the country studying the questions with which they have to deal, they haven't appropriations large enough to admit of the heavy field expenses required for such work.

Take again the subject of glaciation; how would it ever have been possible for any one, confining his observations to any single state, to have formed an opinion or to have reached a conclusion regarding glaciation worthy of utterance. And I venture to say that if there is still a good deal to be learned before we shall fully comprehend the history of the continent during Pleistocene times, it is due to no small extent to the fact that our observations have not yet taken wide enough range.

To be sure there is local work enough on this subject and to spare, but the great question as a whole could never be comprehended, stated, studied, or solved in any single state, or indeed at all unless one had *carte blanche* for his movements.

Professor Irving has well remarked:* What "countless, interminable wranglings as to stratigraphical correlations in the states east of the Mississippi..might have been prevented had any one geologist been able to follow through its whole extent the formation he was studying." But the state geologist is stopped by state boundaries, and the broader questions of stratigraphy and correlation cannot be settled or even satisfactorily discussed by him.

It seems plain that in so far as the relations between the national and the state surveys are concerned the national survey should leave all that it can safely leave to private enterprise and to state surveys, and that it should deal with those problems which state surveys and individuals will not or cannot satisfactorily deal with.

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*The School of Mines Quarterly, Vol. IV, No. 4, June, 1883, p. 288.

ny opinion also that the national survey, being better informed
is going on in the way of geologic work than the state geolo-
nd being in every respect the strongest of our organizations,
hold out a helping hand to the state surveys, and from their
nd more valuable experience, give advice and encouragement to
rk. In this way state aid to scientific work would be encour-
d the national survey would widen its helpful influence.

s without saying that state and national surveys should not ride
hod over each other just because there is no law to prevent
plicating each other's work or their doing work that will inter-
h each other's plans or efficiency. It would be easy for a gov-
survey to discredit and embarrass a state survey to such a point
state would put a stop to its own work. Fortunately our na-
urvey has been conducted rather with a view to aiding the state
. But this aid can be made much more effectual than it ever
n, and I have no doubt it will be made so whenever we are all
r such coöperation.

Inited States Survey and the Colleges.—My own conception of
c organizations is not that they should simply devote themselves
accumulation of scientific facts—to research—but that they
t the same time encourage and develop scientific men.

should have much to do with the training of geologists in proper
s. It will not cost much, and it will look well, and the few ef-
quired by such encouragement must yield valuable results in the
Geologic investigation should, therefore, in so far as possible,

building. What must one's feelings be when he brings his contribution to find that it is in the wrong place, or that it is not wanted? Mistakes of the same sort are constantly being committed in geologic work and in abundance too, all because we have no recognized directing head for the work done outside of the United States Geological Survey.

The bulk of geologic literature must yearly become greater, and unless it becomes at the same time better, we must expect a day to arrive when geologists may well stand appalled before it. Much of this literature is practically worthless; it is an encumbrance rather than a help to the progress of science, and we should feel grateful to any method that would deliver us and geology from an evil which is coming to be a more and more serious one.

In one of the states in which the United States Survey has been doing topographic work, an area of 3,000 square miles that had already been surveyed had to be remapped by the state survey to meet its own demands. Here I think no one will have any difficulty in understanding the necessity of coöperation between the state and the national survey.

Take as another example the chemical analyses made for geologic purposes. The chemists of state and national surveys have thrown upon them a vast amount of heterogeneous work, while but little or no time is left them for original investigations. A great many of their analyses are duplicated elsewhere, or may be duplicated in any number of laboratories, so that investigations that might otherwise have been possible are prevented, and both chemistry and geology are hindered.

The errors committed by geologists not connected with the surveys are mainly due to haste, or in other words, to expression of opinion based upon too limited observations. But only limited observations are possible to men of limited time for the work, and limited means to work with, a limited area to work in, limited acquaintance with field geologists, and limited opportunities for publication.

There are many young geologists and men of but little experience—amateurs—whose efforts are not so directed as to be of as much service as they might be. They lack neither zeal nor means in many cases, but they do lack some one to guide their tottering footsteps. Their want of experience gives them but a restricted view of the field in which they are laboring. Their labors cannot therefore, unless directed by some one who has a sufficiently broad view of the whole field, be of any value to geology. Who will direct them? Or shall they go on piling higher their wasted energies, and find themselves when they have come to the end with the mortification of knowing that though they have worked hard and faithfully, they have in reality contributed nothing to the sum of human knowledge?

So our energies are not fully utilized; we are like a great system of machinery with here a bent shaft wasting the greater part of its energy in friction, there a broken belt that has stopped a useful machine, here a timber caught in the wheels and beating the walls and floors.

If we could have some sort of coöperation, a man at work upon a particular subject would have some assurance that his field of operations e, within all reasonable limits, left to him. As matters now geologist is often obliged to mount guard over his own grounds his own work to keep the unscrupulous camp-followers of from walking off with and getting the credit for the results of rs.

ration would enable each one to concentrate his efforts upon e of work or that investigation in which he is especially inter- As matters have gone heretofore no state survey and no man on survey has been able to take up any one subject in a systematic rough manner unless it has happened that some one group of s been available in his own state alone. Take any topic you ose for a test and you will find this to be an invariable rule.

e best we may, there is not one of us who may not be benefited less by friendly criticism. And it is of great importance to the that these criticisms be made before our results or observations lished. In this way we may avoid adding to that vast talus of trash beneath which the science of geology is buried more and ch year. Such criticism is not possible except under conditions able us to know the lay of the land with reference to other geol- nd to what they have done and are doing.

uld be distinctly understood from the outset that such work is ot subordination, but coördination and above all coöperation.

operation. If ever such operation should be brought about, several points must be kept in mind by us all.

There must be a certain amount of elasticity in any plan that may be adopted, for geological investigation like any other investigation leads us off on many unexpected tangents.

Subordination would have to be largely nominal, for those who do the best and most work would have to take precedence of those who did not so well.

As much latitude as possible would have to be allowed individuality. Men are not like pieces of coal to be separated and classified by sizes or by specific gravity.

Administrative methods devised for scientific work, like those of diplomacy, are often a series of compromises, and good sense must make up for the defects of any system.

No plan of coöperation can succeed if we do not all take a broad and unselfish view of science and its functions; we must work for its advancement; and the idea of putting a caveat on this or that topic must be relegated to the dark ages of geologic science.

Men will be ready to coöperate with us the moment they are made to feel that their contributions are useful and are appreciated, and that they will not lie unattended for years in the hands of some one not impressed with the shortness of time and of human life.

In order to have coöperation each one must do, in addition to the direct objects of his work, what others want.

Local talent should be utilized. It would in many cases save a good deal that now goes to pay travelling expenses, to say nothing of the importance of keeping all the geologists of the country actively interested in geologic work.

A working geologist, if he works intelligently, must know and keep in mind what other people are doing; and he certainly cannot do this if he is working alone, and without any recognized relations to other geologists.

Now if geologic work can be improved by being under the nominal direction of those best fitted to direct, where are we to find our directors? The men who have done most to popularize the science of geology in this country are our professorial geologists, and it is not unnatural that we should turn to them. But the teachers of a science are not necessarily the best directors of research, while they are probably in no case thoroughly conversant with the work being done by the various state surveys and by the national survey.

The direction of work over the whole country would be quite as impossible, or even more so, from the states.

The national survey, standing as it does at the head of all the geologic work done in the country, having the whole national domain as its field, and composed as it is, of our best geologists and having the most thorough organization, is, or should be, the natural head and director of all geological work in this country. I have no doubt that the

al survey would be glad to help in so far as it can to unify and to
seful direction to this work.

ke this ground in the face of the statement of the distinguished
or of the United States Geological Survey who has said that "all
scientific research under national, state, and local patronage,
be controlled by some central authority, as an army by its gen-
rom the fact that scientific men, competent to pursue original re-
, are peculiarly averse to dictation and official management.
ific men spurn authority, but seek for coördination."*

function of a director or of a superior, in science at least, is not,
ure, that of a commander ordering here and there men who must
obey, who must have no independent opinions or plans of their
he must rather be a helper, a man to encourage, to suggest, to
th enthusiasm those under him and to unify the work of the or-
tion of which he is the head. Scientific men do not spurn author-
here is any reason for it, and as a proof of it we may cite the
States Geological Survey itself, as well as all the state geo-
surveys in this country, or for that matter, in the world. The
rs of all these surveys submit to all reasonable authority, but
re also put upon congenial work, and they are permitted to do
ork pretty much in their own way. Now why can there not be
anization of all geologists more or less similar to this?

may disabuse our minds of the thought that there is a probability
a possibility of the government monopolizing geology. It can't
geology belongs to the geologists, whether the government helps

Permit me to carry this simile still further. Hounds understand that it is their business to follow the game, and, when left to their own instincts and wishes, they will follow it. Now imagine a bull-dog seized with the ambition to become a hunter and joining the pack of hounds. Every one knows that the bull-dog will, in spite of anything that can be done, have a fight with half a dozen, or, more likely, with the whole pack of hounds, by the time the chase is well under way.

It is not a pleasing reflection to remember that the great search after truth in which every genuine man of science is engaged, heart and soul, is often interrupted in this same fashion by the pugnaceous disposition of some companion.

Let me recapitulate some of the benefits to be derived from voluntary and cordial coöperation between all geologists and all geological organizations in this country:

I. Geologic research being under the nominal direction of the leading investigators would be so conducted as to be of the greatest utility to the largest number.

II. When a piece of work was done by one it would be done for all, and duplication by state surveys and by individuals and the consequent waste of energy, time and money would cease.

III. The functions and fields of official organizations being better defined, state and national surveys and individuals could so direct their efforts as to serve the purposes of others without neglecting their own immediate aims, and without infringing upon each other's grounds.

IV. National and state surveys would be strengthened and local organizations and individual efforts encouraged.

V. It would give us a better geologic literature, better instruction, better geologists and more thorough specialists.

VI. And finally, we trust, it would put a stop to those oracles who are so ready to prophesy in the name of science.

The comprehensive character of geology requires us to draw upon many cognate branches of science, and successful coöperation among geologists would also react in favor of those sciences, for we need not only the coöperation of the geologists of the country, but that of the engineers, the miners, the meteorologists, astronomers and chemists.

This ideal state of affairs may never be brought about, but it is none the less desirable that we should aim at it; for the more nearly we approximate to it the more rapid will be the progress of science, and the progress of science is the progress of civilization.

To paraphrase a recent utterance of bishop Potter, "It would be a monstrous conception of science if any one of us were to esteem it only as a selfish weapon with which he was to carve his way to personal fame and fortune."* It has often been used for just that purpose, but higher ideals will give us nobler motives.

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*Phi Beta Kappa Address at Harvard, 1890.

EDITORIAL COMMENT.

QUEBEC NOT IN CONFLICT WITH TACONIC.

late paper on the "Quebec Group of Logan," published in
ly number of the *Canadian Record of Science* (Montreal),
William Dawson, it is clearly pointed out that the essential
Sir William Logan in the creation of the Quebec Group
apply a name to a series of strata having "a great devel-
t about the horizon of the Chazy and Calciferous," and
e name is still needed for convenience of use and because
s absolutely no other designation to this day that can be
o include them as a group. In the group so designated
be placed that series of alternating magnesian limestones
ndstones (containing conglomerates in the eastern part of
a) well known in the Mississippi valley, extending from
e of the Trenton limestone to the red sandstones at the top
Keweenawan. In Vermont it has recently been shown by

and lower Cambrian, of modern geologists, and the fossils which he attributes to the Taconic are in great part of this age. That in the subsequent pages of his book in tracing the Taconic through the complex structure of the districts in which it occurs, and enumerating its fossils, he mixes other formations with it is most true. But fair critics of Emmons would do well to eliminate these errors, and leave him the credit of his discoveries in those pre-Potsdam rocks, which, though different in age from the Quebec group, are like it, in the main, a marginal Atlantic series, not represented in the central plateau." (p. 139).

REVIEW OF RECENT GEOLOGICAL LITERATURE.

The Iroquois Beach: a Chapter in the Geological History of Lake Ontario. By **Prof. J. W. Spencer** (Trans. Royal Society, Canada, 1889). Nine or ten years ago Dr. Spencer published his first paper concerning the origin and history of the great lakes. Since then several papers have appeared. But the paper before us is somewhat lengthy and considers the greatest development of lake Ontario, but does not delimit the northeastern margins of the old lake, as researches had not been sufficiently carried on in that direction.

The paper is based upon a great beach representing the only long episode in the history of lake Ontario, between the time that it became a separate lake and the commencement of the formation of the modern beach. The structure of beaches is touched upon, as well as boulder pavements. These questions are, however, more fully treated in "Ancient Shores, Boulder Pavements," etc., a paper appearing in Bull. Geol. Soc. Am., vol. i. The materials of the beaches about the lake (except towards the northeast of the ancient lake margin) are mostly derived from the boulder clay, which generally formed the shores of the old lake, or from modified drift.

The beach is no longer a water level. At Hamilton, at the extreme western end of the lake, the beach is 116 feet above its surface. Upon the northern side, this elevation increases until near Trenton (about 130 miles distant) it is found at a hight of 435 feet. From near Trenton the beach swings around towards the Ottawa river, and has been too imperfectly followed to give absolute results. All of the author's measurements were instrumental levels, except in northern New York, where the barometer was provisionally used.

Upon the southern and southeastern sides of the lake the measurements were those of Mr. G. K. Gilbert. In the eastern direction, upon

thern side of the lake the rise is less marked, the beach being at
ota (southeast of Oneida lake) 192 feet above the lake. But
northward it rises rapidly to 450 feet near Watertown. The de-
ion here recorded in a large measure explains the rocky barrier
the St. Lawrence outlet, compared with the depth of the lake.

question of connection with the sea is considered. Combining
rping of the Iroquois beach with that recorded in the beaches of
er lakes traced all the way to lake Michigan by the author, it is
at the Ontario sheet (called lake Iroquois) was at sea level during
e of the formation of the beach. It is regarded as like the gulf
which has similar proportions with the old lake and its continu-
n what is now the St. Lawrence valley, with the water probably
n the upper portion of the basin. The question of glacial dams
ding the water is regarded as an impossible feature under the
ons, and indeed such ought not to be laid down until the eastern
on of the beach is proved to be absent.

formation of this high beach commenced at the same time as the
a river, which the author places roughly at 26,000 years, based
he mean known rate of recession (which would make it 15,000
ad the fall of water between Erie and Ontario been that of the
day) and the then inferior descent of the waters of the Erie
ausing the erosion to have been less rapid than now, which
engthen the time far beyond the 26,000 years, but which would
ced by various complex causes.

constantly overlooked. Huxley called attention to it many years ago by remarking that exact resemblance between two distant faunas was proof that they were not contemporaneous, inasmuch as there must have intervened sufficient time for migration from one place to the other. Such deposits are, however, homotaxial, because they represent the life of corresponding eras in the two regions. The comparatively small difference in date becomes almost infinitesimal by the side of the immense distance that sunders them both from the present. Geologists are apt to lose sight of the former in their strong appreciation of the latter.

Another chapter treats of the continuity of life, a subject on which no geologist now entertains any doubt. The catastrophes of the earlier investigators such as E. de Beaumont are as dead as their authors, and the remaining gaps in the record give us no anxiety.

The discussion of the doctrine of "colonies" is of great importance. It is well known that the late M. Barrande announced his belief that whole groups of species appeared in a local and transient manner at certain places before appearing as an established fauna. Thus he maintained that Silurian species could be found in spots in Bohemia among Ordovician (Lower Silurian) strata, and that the alternation occurred several times before the permanent establishment of the later fauna took place. Now while there is little difficulty in accepting this doctrine if confined to species differing but little in age, it has been difficult to admit the alternation or simultaneous existence of faunas so widely distant as the Ordovician and Silurian. Only the high authority of Barrande could have given it the currency that it has obtained. Our author is evidently in favor of accepting the view of Mr. Marr that these seeming colonies are only results of repeated faulting-down of Silurian among Ordovician rocks. In this case the seeming difficulty is removed and the so-called "colonies" have no existence.

In the chapter on the imperfection of the geological record the argument originally put forward by Darwin is developed with great force and clearness. The author shows that the want of hard parts is one of the chief causes of this imperfection and brings in evidence the fact that in the various groups of the animal kingdom those families are, on the whole, abundantly represented whose living species possess hard skeletons. Thus among the rhizopods, the Amœbea and Monera are missing from the rocks, but the foraminifers and radiolarians (at present calcareous and siliceous) are exceedingly abundant. So the Myxospongiæ (soft) are absent, but the Porifera (hard) abound in the fossil state. Likewise the hydras and medusas, the sea-anemones and ctenophores are wanting, but the corals, graptolites and stromatoporoids compose vast masses of rock. Other similar cases are cited.

Views on geological climate are expressed with great caution. In the present conflicting state of the evidence this is the only wise plan. Eminent geologists and physicists so widely differ in opinion that no confidence can be felt in any positive statement.

The composition of the work has been divided between the authors in accordance with their palæontological pursuits for many years past.

icholson takes the invertebrates and Mr. Lyddeker the verte-

well to remark at the outset that the arrangement is not "strati-
al" as in Lyell's "Elements." That is, it does not follow the
cal sequence of the formations. It is entirely zoölogical. While
ar less convenient for the student of a special horizon, it is the
y of treating the subject in a biological manner and avoiding
t repetition. It is, of course, subject to the inconvenience that
sils of the various systems are mingled in such a way as to
the "facies" whereby a system may be readily recognized and
at reason less suited to a beginner than the other arrangement,
a geological museum, zoölogically arranged, is almost infinitely
to a young geologist.

ng now to the body of the work and beginning with the lowest
e rhizopods, very slight traces of the Foraminifera have been
h below the Carboniferous rocks, but in these they become so
nt that rock-masses are composed of their remains, such as the
usulina limestone of Russia. The white chalk of Europe is con-
as closely resembling the Globigerina ooze of the Atlantic, the
roportion of silica in the former being chiefly due to its segrega-
flint—a fact bearing on some modern geological problems.

mmary of the arguments anent Eozoon is appended in which the
very fairly stated, the author considering that the vexed ques-
garding its nature is still incapable of final solution. He adds

nodular flints in the white chalk have been produced by the solution of the skeletons of flinty sponges and the redeposition of the silica in solid form."

But the author is especially at home among the Cœlenterata which have formed the chief object of his studies for many years. Accordingly, we find them treated at considerable but not, considering their importance and difficulty, too great length, in 170 pages. It is manifestly impossible here to follow our author in any detail, but a few points may be noted. He is apparently inclined to regard that most ancient fossil Oldhamia as of vegetable rather than of animal origin, an opinion in which we think few will agree with him. If organic, it is more likely that a frond of a zoöphyte should have been preserved from Lower Cambrian days than a sea-weed. The recent discovery of trilobites in strata of similar age in N. Wales is rather significant in the same direction.

In the jelly-fish here belonging (Lucernarida) we find curious evidence of the possibility that one of these soft-bodied creatures may leave a lasting impression on the rock, so that if not itself a fossil the record of its existence at least survives. From the famous quarries of smooth lithographic limestone at Solenhofen has come a cast considered to represent the swimming-bell of a jelly-fish, and Nathorst, of Sweden, has shown cause for believing that Torell's so-called plant "Eophyton" is only the trail of one of these animals in soft mud.

In the chapter on stromatoporoid corals, the author, in speaking of the anomalous genus "Bentricea," inclines to the view that its nearest relationship is here and that it is allied to Labechea and Idiostroma, but at the same time refrains from any positive statement.

As might be expected the Zoantharia are very fully and excellently treated. The author's familiarty with this branch of his subject is well shown by the wealth of illustration here displayed, much of which is original. In no part of the subjects of the first volume is the progress of the science more clearly shown than here. Any one who recalls the time when Milne Edwards and Lonsdale commenced their labors, will remember what a chaos this part of our museums and treatises exhibited. Corals were the "bête noire" of the collector and of the student. But thanks to the recent laborers in this field, among whom Prof. N. has been by no means the least, and thanks also perhaps in an equal degree to those who have so vastly improved the mechanical processes of cutting, slicing and polishing specimens, the light is beginning to dawn where all was previously darkness, and before long we may hope to be able to refer well preserved fossil corals to their proper zoölogical position with reasonable certainty.

In the difficult group of the monticuliporoids the author confesses the difficulty which he feels regarding their zoölogical affinity—whether they should be regarded as a peculiar group of corals or an equally peculiar group of Polyzoa.

Echinodermata are treated under the two heads of Echinozoa and Pelmatozoa. Of these the latter are by far the more important in palæontology in consequence of the great numbers and exquisite beauty of the class Crinoidea which it contains. Dr. N. adopted the classification of Wachsmuth and Carpenter, and divided them into the Palæocrinoidea and Neocrinoidea, the former comprising all the known palæozoic crinoids, and nearly corresponding with Müller's Tesselata; the latter including all post-palæozoic crinoid forms and nearly corresponding with Müller's Articulata and Costata.

The distinctive characters of the first group are a calyx large and massive compared with the arms, interradial plates usually present and often united with the radials so as to form part of the calyx; and interradial plates specially developed rendering the calyx unsymmetrical, and also the presence of a plated vault on the ventral surface. In these points they differ from the Neocrinoidea.

But in an appendix the author says that while the work was passing through the press the discovery was made of the ventral coverings of Encrinus and Taxocrinus, "the latter genus having a plated disc exactly like that of a neocrinoid" and thus bridging over the previously existing gap between the two groups.

Owing to the softness of the bodies of the Annelida the palæontologist has usually to deal with merely the tracks which they left on the sands. The reference of one of these, Scolithus, to the Clinton group is probably an error for the Medina. Many of the so-called plant-fossils of the older rocks are attributed by Nathorst to the tracks of annelids. Curious vermiform masses at Solenhofen are probably fossil worm-casts.

On the other hand the author shows that the Myrianites of Europe and North America is not a trail at all but "the edge of some vertical laminar expansion lying at right angles to the strata." In regard to Grossopodia the suggestion is made that it may have been produced by a gasteropod, and the trail of *Purpura lapillus* is given in illustration.

Regarding the well known and disputed conodonts there seems to be some divergence of opinion between the two authors, one of them speaking of these minute fossils as belonging to the invertebrata and the other apparently inclined to favor a higher origin. See pp. 480 and 922.

The Arthropoda occupy rather more than 100 pages, and of these the Crustacea are treated under fifteen orders, a few, as might be expected, monopolizing most of the space. These are the Ostracoda and Phyllopoda, the trilobites and eurypterids. The chapter on the former gives an excellent and very condensed summary of what is at present known* with details in regard to the recent discoveries of the locomotive organs of this remarkable extinct order. Hither the author refers Climactichnites, noting the suggestion that it may have been the track of an eurypterid. No eurypterid is, however, known from the Potsdam rocks where these trails occur. Rusichnites he considers with Dawson the cast of the burrow of a trilobite as it is sometimes connected with a series of markings resembling Asaphoidichnus. A very useful summary of the classification of the order is appended according to Barrande.

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* We may remark in regard to one point, that the vertical range of Conocoryphe is given as from the upper Cambrian to the Ordovician but the recent discovery of *Conocoryphe viole* in the Penrhyn slates of north Wales carries this genus down to a much earlier date in the Lower Cambrian

The Malacostraca and the eurypterids are dismissed somewhat briefly, the former in ten, and the latter in four, pages.

The Arachnida have of late awakened great interest in consequence of the almost simultaneous discovery of Scorpions in Gothland, Scotland and New York, in Silurian strata, the earliest previously known being of Carboniferous age. Although the evidence of the air-breathing habit in those animals is not so strong as might be desired there can be no doubt of their zoölogical relationship. Possibly they were aquatic. The author says, "It is probable that some of the more ancient forms were littoral in habit." He includes all the three described, Palæophonus, Eoscorpius and Proscorpius.

A few years ago no fossil insect was known except those which attracted attention by being found in amber. But now a large insect fauna has been discovered and by the labors of M. Brongniart and Mr. Scudder the broken fragments have been studied and we already have a fair idea of the line of development of the class. "Between 2,000 and 3,000 species of fossil insects have been described."

The oldest known insect is Palæoblattina douvillei, from the Silurian of France. No more are known till we reach the Upper Devonian of North America. The Carboniferous, both of Europe and America, is rich in insect remains. The Trias of Colorado, the Lias and Wealden of England, Germany, and Switzerland, the Oölite of Solenhofen and the Tertiary on both continents, have all contributed largely to the history of insect-life.

All palæozoic insects are included in the Palæodictyoptera of Scudder, a group of generalized hexapods in which metamorphosis was not complete, the four wings were equally developed and the neuration was simple. The four groups into which this order is divided—the orthopteroids, the neuropteroids, the hemipteroids, and the coleopteroids, foreshadow the four modern orders after which they are named.

At later dates more clearly defined representatives of these orders began to appear—the Hemiptera, in the Jurassic as cicadas, and in the Cretaceous as plant-lice and water-scorpions, the Orthoptera in the Trias as cockroaches, the Neuroptera in the Lias as white ants, etc. Of insects undergoing complete metamorphosis the Diptera, with a few exceptions, appear first in the Tertiary, chiefly in amber, the Lepidoptera in the Jurassic and Cretaceous, and the Hymenoptera in the Middle Tertiary, excepting the *Palæomyrmex* of Heer, if correctly determined, from the Swiss Lias, and a very few other Mesozoic forms. The Curculionidæ, according to Mr. Scudder, are the oldest of the Coleoptera and date from the Triassic. Most of the leading existing families of this order had representatives at about the same epoch.*

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*The writer has some specimens of Trigonocarpon from the English Coal-measures, which have apparently been bored by the larva of some insect, probably a weevil. This would indicate a yet greater age for some of the group of the Curculionidæ.

[illegible] the author has made liberal use of his [illegible] and his pages exhibit a number of [illegible] the western continent. These, of course, [illegible] the Cheilostomata being [illegible]

[illegible] Brachiopoda to which belong the [illegible] excepted) is well treated, [illegible] The work of Davidson of course here forms [illegible] families into which the class [illegible]

[illegible] contains a good sketch of the [illegible] as it relates to palæontology [illegible] It is, however, so condensed [illegible] of it. The nature of the [illegible] favorite topic with palæontolo- [illegible] of much new matter in [illegible]

[illegible] we note that the three air- [illegible] the genera Cyclostoma, Acicula and [illegible] in spite of their possess- [illegible] structural features being considered [illegible] classification of the group according [illegible] is not applicable, as the of Dawson from the Carboniferous of Nova Scotia, and save a few intermediate fossils we must wait till the Tertiary age for the frequent appearance of the now abundant land and fresh-water snails.

On the other hand the cephalopods are the most important, attractive and interesting of all the fossil molluscan fauna. Not however so much in their higher types as in their lower forms, for excepting the Belemnites of the Lias, Oölite and Chalk, the dibranchs now so abundant require small space in a manual of palæontology. Of the genus Belemnites alone three or four hundred species are already known. A few forerunners of the coming host come up from the Trias and equally few descendents linger on into the Miocene but as a whole the group is specially characteristic of Liassic, Oölitic and Cretaceous strata.

But the tetrabranchs are among the most wonderful and beautiful of fossils. In the palæozoic rocks the nautiloid type prevailed with simple sutures and siphuncle variable in position and often contracted. Regarding this group Prof. N. says:

"The earliest types of the Nautiloidea appear in the Upper Cambrian deposits where the genera Orthoceras and Cyrtoceras are represented. In the Ordovician rocks an enormous number are known, no fewer than 463 species having been recorded by Barrande from rocks of this age in Bohemia alone." "The maximum development of the group takes place, however, in the Silurian age, the Bohemian area having yielded to the researches of Barrande over 1,000 species. In the later palæozoic rocks the nauliloids exhibit a progressive diminution in numbers and only Nautilus and Orthoceras survive the close of this period, the latter finally dying out in the Trias. The few known Tertiary types belong to Nautilus or closely allied forms, and the sole existing representatives of the sub-order are four living specie of Nautilus."

Two genera only of this great family have the septal necks directed forward—Bathmoceras and Nothoceras. In all others they are as in the modern Nautilus.

But it is after passing into the Mesozoic age that the full glory of the tetrabranchiates appears. The long straight shell so frequent among the nautiloids has given place to an elegant spiral, and the simple septa have been replaced by others with plaits and folds so complicated and beautiful that their outline gives a dendritic appearance to the casts of the shell.

In late mesozoic times the cephalopod shell shows a tendency again to uncoil and the perfect spiral of the ammonite is succeeded by the imperfect or partial coil of the hamite, scaphite and even the straight baculite. But in regard to these genera we cannot do better than quote the words of our author —

"Formerly all these forms were grouped under a comparatively small number of the genera such as Ceratites, Ammonites, Hamites, Turrilites, Baculites, etc., distinguished mostly by the mode of growth and the resulting form of the shell. By far the most important of these groups was the comprehensive genus *Ammonites* embracing the great series of forms commonly known as "Ammonites." Through the researches of Hyatt, Neumayr, Mojsisovics, Waagen, von Zittel and others it has now been shown that the old genus *Ammonites* can no longer be retained but that the types formerly included under this name admit of a natural division into a number of genera which in turn constitute a number of distinct families. These modern divisions are distinguished by such characters as the size of the body chamber, the form of the sutures, the shape of the aperture and the presence or absence of an Aptychas."

In accordance with this principle the names *Phylloceras*, *Haploceras*, etc., have been introduced in place of the old term *Ammonites*. If it had been possible to use a uniform termination the transition would have been attended with little difficulty, but this was not done. It is consequently usual, and, indeed, almost necessary, to give in addition the old name to prevent needless trouble. Thus we read *Hoplites* (*Ammonites*) *falcatus*.

"The earliest representatives of this vast group of the ammonoids appear in the Trias. In the Mesozoic it undergoes a vast development. In the Cretaceous rocks new and varied types are found but at its close the entire group of the Ammonites underwent an apparently sudden and almost complete extinction."

Regarding the bodies called "Aptychus" the author gives no opinion merely quoting the two views, viz., that they were protective plates developed within the walls of the nidamental gland in which case all such ammonites must be females, and that they are produced by the calcification of the hood and served as the operculum to those species that possessed them. In the former case they were nearly homologous to the "shell" of this argonaut.

The author has been very careful in regard to the terminology—a stumbling-block to many palæontologists—sometimes in consequence of their want of classical knowledge, and occasionally, we fear, in consequence of indifference to the details of the work. For this the accurate worker will feel much indebted to him. Incorrect formation of terms is a great annoyance to those who realize it, especially when with the incorrectness comes, as is often the case, an uncouth and unmelodious sound.

At a later date we will follow Mr. Lyddeker through the second volume of this valuable manual.

Geological and Palæontological Relations of the Coal and Plant-bearing Beds of Palæozoic and Mesozoic Age in Eastern Australia and Tasmania; with special reference to the Fossil Flora. Described, illustrated, and compared with Analogous Deposits in other Countries. By OTTOKAR FEISTMANTEL, M. D., *etc.*, *Sydney, New South Wales, 1890.* This is No. 3 of the Palæontological series of memoirs published by the Geological Survey of New South Wales. The coal and plant-bearing beds of eastern Australia and Tasmania are typically represented in New South Wales and include *Silurian beds* with a plant, *Spirophyton*, *etc.*: the *Goonoo Goonoo beds* with *Lepidodendron nothum* etc., referred to the Devonian; *Lepidodendron beds*, rich in fossil plants, belonging to the Lower Carboniferous: *Marine beds* with intercalated coal measures of the age of the middle and upper Carboniferous; *Newcastle beds*, with coal, and regarded as Permian; and the *Hawkesbury-Wianamatta* beds, with coal and numerous fossil plants, referred to the lower Mesozoic. Corresponding series of strata occur in Victoria, Queensland and Tasmania.

A conglomerate occurring in the *Marine beds* of the Upper Carboniferous contains erratic blocks together with striated boulders and pebbles, and the Australian geologists conclude that it has been formed largely through the agency of drifting ice. It would thus seem that the southern hemisphere at least had been subjected to the rigors of a glacial epoch near the close of the Palæozoic. During this period of low temperature we have the beginning of a Mesozoic flora which, associated with a Carboniferous fauna, persists in increasing numbers of genera and species throughout the time represented by the *Newcastle*, or *Permian* strata. Dr. Feistmantel correlates the Carboniferous conglomerate of New South Wales with the Bacchus Marsh beds of Victoria, the Talchir group of India, and probably with the Karoo formation of Africa, all of which groups seem to belong to the horizon of the upper Carboniferous and all, according to competent authorities, appear to have been formed in part at least by the action of floating ice. The volume contains 183 pages, 70 pages being devoted to bibliography, and correlation of strata, and the remainder to description of species. A few species of fishes and amphibia are noted, but the work is chiefly devoted to the description of fossil plants. Thirty plates illustrate the species described.

Records of the Geological Survey of New South Wales. Vol. I, Part III, 1889. This part of of Vol. I embraces pages 149–183 and Plates XXV–XXX. The table of contents will give an idea of the scope of the publication. The articles, numbered XVI to XIX, inclusive, are:

On the occurrence of the Genus *Meiolania* in the Pliocene Deep Lead at Canadian, near Gulong; With Plates XXV and XXVI; by R. Etheridge, Jr., Palæontologist.

The Leucite-Basalts of New South Wales, with Plates XXVII and XXVIII: by T. W. Edgeworth David and William Anderson, Geological Surveyors.

On our present knowledge of the Palæontology of New Guinea, with Plate XXIX; by R. Etheridge, Jr., Palæontologist.

On the Mineral Spring at Rock Flat creek, near Cooma, Monara District, with Plate XXX; by William Anderson, Geological Surveyor.

Mr. Etheridge introduces his first paper by saying, "So far as I am aware, neither the remains of the large extinct Lacertilian *Megalania* (? *Varanus*) *prisca*, Owen, or either species of the horned Chelonian *Meiolania* have so far been found in any of the New South Wales Pliocene or Post-Tertiary deposits. Both genera were met with in accumulations of the latter age in Queensland, and the last named at Lord Howe Island."

ssil Fishes of the Hawkesbury Series at Gosford. By ARTHUR
OODWARD, F. Z. S., F. G. S. Sydney, 1890. This volume of
nd 10 plates is No. 4 of the palæontological series of memoirs
ological Survey of New South Wales. It is devoted to the
n and illustration of an interesting series of fossil fishes,
ken with the previously described forms from the same hori-
rm the views respecting the Triassic age of the Hawkesbury-
tta series of New South Wales.

Australian Fossils. 1. Stromatoporoidea. By PROF. H. A.
N, M. D., F. G. S. 2. Corals and Polyzoa. By GEORGE JEN-
NDE, Ph. D., F. G. S. (Extracted from the Geological Maga-
ade III, Vol. VII. May, 1890.)
omatoporoids noted by Dr. Nicholson in this paper are *Actin-*
lathratum and Stromatoporella eifelensis, species originally
by Nicholson from the middle Devonian of Germany, and now
occur at the same horizon on the opposite side of the globe in
Australia. The corals and polyzoa by Dr Hinde embrace Devo-
Carboniferous forms. Seven of the species are new, and a new
ame, *Plerophyllum*, is proposed to take the place, probably of
nck's *Pentaphyllum*, a name first employed in 1821 to designate
f Coleoptera.

Stoliczkaria and Syringosphæridæ: PROF. P. M. DUNCAN in the Records of the Geological Survey of India, vol. xxiii, part 2, p. 80, brings forward undeniable proofs that his genus *Stoliczkaria* is quite distinct from *Heterastridium* A. E. von Reuss. According to Prof. Duncan, Dr. Nicholson has figured a section of what the latter considers to illustrate the minute structure of *Stoliczkaria* Dunc., which Prof. Duncan says is not a section of his genus but of *Syringosphæridæ* and Dr. Nicholson again falls into error by figuring *Stoliczkaria granulata* Dunc. which is clearly *Syringosphæria porosa* Dunc. The paper then continues by describing two new species and two new varieties of *Syringosphæridæ*, *S. medlicotti*, *S. intermedia* sp. nov. *S. plana* and *S. monticulariæ*, var.

The Geographical Distribution of Fossil Plants. By LESTER F. WARD. Pages 663–960, with map. (Accompanying the eighth annual report of the director of the U. S. Geological Survey.) This is a well arranged and practically complete review and bibliography of the literature of paleobotany. The published investigations which have been made in all countries are noticed in geographic and chronologic order, with identification of the geologic horizons as far as practicable, 114 pages being devoted to the countries and provinces of Europe, 13 pages to those of Asia, 18 pages to Africa, the Sunda islands, and Australasia, and the remainder to the Arctic regions and North and South America. Forty-five states and territories of the United States, including the District of Columbia, the Yellowstone National Park, and Alaska, have fossil plants, the richest being Pennsylvania with its great representation of the coal flora. The accompanying map shows the localities of fossil plants in this country, colored to distinguish their geologic age. A good index, including more than 7,000 references, makes this work a most convenient and valuable manual.

The Paleozoic Fishes of North America. By JOHN STRONG NEWBERRY. pp. 340; plates 53. (Monographs of the U. S. Geol. Survey, vol. xvi, 1889). After referring to Prof. E. W. Claypole's discovery of Pteraspidian fishes in the Upper Silurian rocks of Pennsylvania, the earliest fossil fishes thus far known, Dr. Newberry describes, in about 50 pages, the distribution and the generic and specific characters of the fishes of our Devonian system, which, as he states, is perhaps better represented in eastern North America than anywhere else. The next 150 pages similarly treat the fishes of our Carboniferous rocks, in which both their numbers and variety far surpass the preceding period. No Permian fishes from this country have come under the author's observation; and the remainder of the volume consists of the plates, with their explanations, and the index. In a previous monograph (xiv of this series) Dr. Newberry has described our Triassic fishes, gathering in these two volumes the results of many local surveys. Prominent among these in its wealth of Paleozoic ichthyology is the geological survey of Ohio, for which Dr. Newberry, in his reports on the paleontology of that state, has discussed the classification of our older fossil fishes and their relations to living forms.

Vood and Lignite of the Potomac Formation. By FRANK HALL
ɔN. pp. 72; plates 7. (Bulletin of the U. S. Geol. Survey, No.
The first part of this report gives a concise history of the
of study of the internal structure of fossil wood and lignite,
bibliography of this subject. Lignite and silicified wood occur
otomac formation on the Potomac and James rivers, and in
e. One of the trunks of silicified wood, exposed by the excava-
he new reservoir in Washington, was between 30 and 40 feet
h a diameter of nearly 2 feet. Generally the tissue of the sil-
ecimens is very perfectly preserved, and five species are de-
ll of them new, four being referred to the genus Cupressinoxy-
ne to Araucarioxylon. A summary of Mr. Knowlton's inves-
as been presented in the GEOLOGIST, February, 1889.

CORRESPONDENCE.

ACIATION OF THE CORDILLERA AND THE LAURENTIDE. In the
paper on the *Glaciation of the Northern Part of the Cordillera*

or New England side of the main axis. This region has therefore been occupied with ice which formed separate and independent sheets in the Pleistocene period, and I would prefer for them the designation of the *Appalachian system of glaciers*. These seem, so far as observations extend, to have been largest on the New England slope, and formed there, in some areas at least, massive, confluent ice-sheets, which, in their movements were comparatively independent of minor surface features. Reasoning from the analogy between existing glaciers in different parts of the world, and those of the Post-Tertiary age, it seems now a pretty safe inference as regards the latter, that the largest ice-masses must have accumulated at or near the borders of continents, where the conditions of moisture, temperature, etc., as well as the topographic features, were most favorable for their development. It is just possible too that the glaciers of the eastern and western parts of North America may not have been strictly contemporaneous, *i. e.*, may not have reached their maximum thickness and extent at the same time, as suggested by Mr. Israel C. Russel in his valuable paper entitled *Notes on the Surface Geology of Alaska* (Bulletin Geol. Soc. of America, vol. i., pp. 99–182).

Belledune, New Brunswick, Can., ROBERT CHALMERS.
Sept. 8th, 1890. Geol. Surv. of Can.

PERSONAL AND SCIENTIFIC NEWS.

PROF. F. P. VENABLE enumerates twenty-three meteorites with brief descriptions, which have been reported as found in North Carolina. Of these nearly all have passed out of the state, not even fragments being preserved there. Considering that for the entire world there have been recorded, according to Huntington's catalogue of 1887, only 424 meteorites that have reached the earth, North Carolina may be considered to have been well reported. The list is valuable, and evinces much labor and patient research. It is published in the Journal of the Elisha Mitchell Society, vol. vii., pp. 33–52, 1890.

MR. I. C. RUSSELL, OF THE UNITED STATES GEOLOGICAL SURVEY, lately returned from Alaska where he made a careful examination of the phenomena of existing glaciers, having been absent since the opening of the season of 1890. According to Mr. Russel there is a large amount of ice-covered country, more than has been supposed, much of the tundra region being underlain by ice at the depth of a few feet or inches. There are also many moving glaciers. The tundra ice which underlies thousands of square ears no trees, only moss and small shrubs; but in the re- glaciers the surrounding country is apt to be forested.

OCCURRENCE OF GONIOPHYLLUM PYRAMIDALE HISINGER, IN A.—The fact that *Goniophyllum pyramidale* Hisinger in America seems to have escaped general notice, although tence here has been known to some geologists for a number s. So far as I know, the first individuals of this species n this country were discovered by professor W. H. Norton, ell College, Iowa. They were taken from strata of the period, near La Motte, Dubuque Co., Iowa. Since the scovery individuals of the same species have been found onticello, Maquoketa, and a few other places in the same The first specimens were submitted to Dr. Rominger for cation, and casts were distributed by Prof. Norton to a of geologists, but it would seem that the fact that this r and very interesting genus and species occurs on this side Atlantic has not yet found a place in geological literature. species known to occur in America outside of Iowa? It be interesting to know its geographical range.

WESTERN SOCIETY OF NATURALISTS will hold its annual g in the buildings of Purdue University, at LaFayette, In- Wednesday and Thursday, November 12th and 13th, 1890.

THE
AMERICAN GEOLOGIST

VOL. VI. DECEMBER, 1890. No. 6.

ON THE CAUSE OF THE GLACIAL PERIOD.

By WARREN UPHAM, Somerville, Mass.

The fascinating astronomic theory that the Glacial period was due to meteorologic conditions brought about by a stage of maximum eccentricity of the earth's orbit, extending from 240,000 to 80,000 years ago, which Croll and James Geikie have so ably advocated, is doubted from the meteorologist's standpoint by Woeikof, and seems wholly untenable in view of the geologic evidences that not many thousands of years have passed since the departure of the ice-sheets.

In various localities we are able to measure the present rate of erosion of gorges below water-falls, and the length of the postglacial gorge divided by the rate of recession of the falls gives approximately the time since the Ice Age. Such measurements of the gorge and falls of Saint Anthony by Prof. N. H. Winchell show the length of the postglacial or recent epoch to have been about 8,000 years;[1] and from the surveys of Niagara falls, Mr. G. K. Gilbert believes it to have been 7,000 years, more or less.[2] From the rates of wave-cutting along the sides of lake Michigan and the consequent accumulation of sand around the south end of the lake, Dr. E. Andrews estimates that the land there became uncovered from its ice-sheet not more than 7,500

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[1] Geology of Minnesota, Fifth annual report, for 1876; and Final report, vol. ii, pp. 313–341. Quart. Jour. Geol. Soc., vol. xxxiv, 1878, pp. 886–901.

[2] Proceedings, A. A. A. S., vol. xxxv, for 1886, p. 222. "The History of the Niagara River," Sixth An. Rep. of Commissioners of the State Reservation at Niagara, for 1889, pp. 61–84.

U of M

ago.[3] Professor Wright obtains a similar result from the of filling of kettle-holes among the gravel knolls and called kames and osars, and likewise from the erosion of s by streams tributary to lake Erie;[4] and Prof. B. K. son, from the rate of deposition of modified drift in the cticut valley at Northampton, Mass., thinks that the time the Glacial period cannot exceed 10,000 years.[5] An equally estimate is also indicated by the studies of Gilbert[6] and ll[7] for the time since the last great rise of lakes Bonneville ahontan, believed to have been contemporaneous with the reat extension of ice-sheets upon the northern part of our ent.

f. James Geikie maintains that the use of palæolithic imple- had ceased, and that early man in Europe made neolithic hed) implements, before the recession of the ice-sheet from nd, Denmark, and the Scandinavian peninsula;[8] and wich suggests that the dawn of civilization in Egypt, China, ndia, may have been coeval with the glaciation of north- rn Europe.[9] In Wales and Yorkshire the amount of denuda-

Another indication that the final melting of the ice-sheet upon British America was separated by only a very short interval, geologically speaking, from the present time, is seen in the wonderfully perfect preservation of the glacial striation and polishing on the surfaces of the more enduring rocks. Of their character in one noteworthy district, Dr. Bell writes as follows:—"On Portland promontory on the east coast of Hudson's bay, in latitude 58°, and southward the high rocky hills are completely glaciated and bare. The striæ are as fresh-looking as if the ice had left them only yesterday. When the sun bursts upon these hills after they have been wet by the rain they glitter and shine like the tinned roofs of the city of Montreal."[12]

Forbidden by the shortness of the postglacial epoch from attributing the Ice Age to the astronomic condition of maximum eccentricity, we must look for other causes of this extraordinary geologic period; and these seem to be found in great uplifts of the glaciated areas, of which for this continent Prof. J. W. Spencer has given an impressive review in the recently published first volume of the Bulletin of the Geological Society of America. Though he has not proceeded to interpret these observations as revealing in continental elevation the probable cause of the colder climate and accumulation of ice-sheets during the Glacial period, I believe that this is a legitimate conclusion, and that it strongly reinforces the arguments long ago advanced by Lyell and Dana and recently emphasized anew by Wallace. The submarine border of the continental plateau to depths of more than 3,000 feet is cut by valleys or channels, which if raised above the sea level would be fiords or cañons. These can be no other than river-courses eroded while the land stood much higher than now; and its subsidence evidently took place in a late geologic period, else the channels would have become filled with sediments.

According to the United States Coast Survey charts, as noted by Spencer, the bottom of a submerged valley just outside the delta of the Mississippi is found by soundings at the depth of 3,000 feet. This valley is a few miles wide and is bounded by a plain of the sea bed from 900 to 1,200 feet above its floor. It thus appears that the country north of the Gulf of Mexico has been raised for a short time to a hight of not less than 3,000 feet; and it is important to note in passing that an equal uplift would

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[12] Bulletin, G. S. A., vol. i, p. 308.

close the Strait of Florida, 2,064 to 3,000 feet deep,
h which the Gulf Stream now pours into the North
tic.

continuation of the Hudson river valley has been traced by
ed hydrographic surveys to the edge of the steep continental
at a distance of about 105 miles from Sandy Hook. Its
ost twenty-five miles are a submarine fiord three miles wide
om 900 to 2,250 feet in vertical depth measured from the
of its banks, which with the adjoining flat area decline from
600 feet below the present sea level. The deepest sounding
fiord is 2,844 feet.[13]

unfinished survey by soundings off the mouth of Dela-
ay finds a similar valley submerged nearly 1,200 feet, but
t traced to the margin of the continental plateau.

in, the United States Coast Survey and British Admiralty
, as Spencer states, record submerged fiord outlets from the
f Maine, the Gulf of Saint Lawrence, and Hudson bay,
tively 2,664 feet, 3,666 feet, and 2,040 feet below sea level.
ed of the old Laurentian river from the outer boundary of
shing Banks to the mouth of the Saguenay, a distance of

by channels twenty to thirty miles wide and 600 to 1,000 feet deep, were still a part of the mainland during the late Pliocene and early Quaternary periods.[16]

In northern California Prof. George Davidson, of the U. S. Coast Survey, as cited by Spencer, reports three submarine valleys about twenty-five, twelve, and six miles south of Cape Mendocino, sinking respectively to 2,400, 3,120, and 2,700 feet below the sea level, where they cross the 100 fathom line of the marginal plateau. If the land here were to rise 1,000 feet, these valleys would be fiords with sides towering high above the water, but still descending beneath it to profound depths.[17]

Farther to the north, Puget sound and the series of sheltered channels and sounds through which the steamboat passage is made to Glacier bay, Alaska, are submerged valleys of erosion, now filled by the sea but separated from the open ocean by thousands of islands, the continuation of the Coast Range of mountains. From the depths of the channels and fiords Dr. G. M. Dawson concludes that this area had a preglacial elevation at least about 900 feet above the present sea level, during part or the whole of the Pliocene period.[18]

The general absence of Pliocene formations along both the Atlantic and Pacific coasts of North America indicates, as pointed out by Prof. C. H. Hitchcock, that during this long period all of the continent north of the Gulf of Mexico held a greater altitude, which from the evidence of these submarine valleys is known to have culminated in an elevation at least 3,000 feet higher than that of the present time. Such plateau-like uplift of the continent appears to have exerted so great influence on its meteorologic conditions, bringing a cooler climate throughout the year, that it finally became enveloped by ice-sheets to the southern limit of the glacial striæ, till, and moraines, stretching from Nantucket and Cape Cod to New York city, Cincinnati, Saint Louis, Bismarck, and thence westward to the Pacific somewhat south of Vancouver island and Puget Sound. The thickness of the ice in the region of the White mountains and the Adirondacks was about one mile; and Dana has shown, from the directions of striation and transportation of the drift, that its central portion over the Laurentian ds between Montreal and Hudson bay had probably a ss of fully two miles. In British Columbia, according to M. Dawson's observations, it covered mountain summits o 7,200 feet above the sea.[19]

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[16] Bulletin of the California Academy of Sciences, vol. ii, 1887, pp. 515–520.

[17] Ibid., vol. ii. pp. 256–8.

[18] Canadian Naturalist, new series, vol. viii. pp. 241–248. April, 1877.

e thus heavily ice-laden, nearly the whole glaciated area low its present level, but for the most part only to a mount in comparison with its previous elevation. Begin- or near a line drawn northeastward through New York oston, and Nova Scotia, the extent of the submergence of d by the sea, at the time of the recession of the ice-sheet, wn by fossiliferous marine deposits overlying the till, es from 150 and 225 or 230 feet on the coast of New hire and Maine to 520 feet at Montreal; 300 to 500 feet country southwest of James bay; and about 1,500 feet, ng to Dr. Robert Bell, at Nachoak on the eastern coast of or. In British Columbia, including Vancouver island and en Charlotte islands, Dr. Dawson finds evidence of sub- ce to the amount of 200 or 300 feet while the glacial ns still endured. During postglacial time the Atlantic cific coasts have been again uplifted, attaining generally a feet, with a deep submerged valley running from it west and north to the abyssal Arctic ocean.[22]

Under the weight of its ice-sheet, the glaciated area of Europe, like that of North America, sank mostly to a somewhat lower level than it now has, the maximum depression being on the coast of Norway, about 580 feet.[23] From this depression Scandinavia has gradually risen, with pauses during which beaches were formed; and the uplift of that country, as of the region about Hudson bay, continues to the present day.[24]

This subject may be advantageously examined from another point of view, by inquiring what we may learn of the oscillations of the land and its climatic changes during the Quaternary era from the enforced migrations of the flora and fauna of northern countries. The influence of the Glacial period on the distribution of plants and animals has been fruitfully investigated by Edward Forbes, Asa Gray, Alfred Russel Wallace and others, who have thus explained many peculiarities in the geographic range of species, as the occurrence of Arctic plants on the summits of mountains in temperate latitudes, and the identity of a considerable number of species found in the floras of both the United States and Japan, but absent from Europe. As geologists are lately finding valuable additions to our knowledge of important orographic movements of our continent during the Mesozoic, Tertiary and Quaternary eras, from the present conditions of its rivers and their relation to geologic formations, so the pages of the geologic record receive a useful side-light from the range of living species. Professor Gray well stated this bearing of botanic science upon geology, in the conclusion reached by his comparison of the floras of Japan and North America, "that the extant vegetable kingdom has a long and eventful history, and that the explanation of apparent anomalies in the geographical distribution of species may be found in the various and prolonged climatic or other physical vicissitudes to which they have been subject in earlier times."[25]

The general likeness of the Arctic flora all around the globe, the many instances of relationship and identity in the north tem-

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[22] Nature, vol. xxiii, p. 393, with map of submarine contour.

[23] Geol. Mag., III, vol. vi, 1889, pp. 157, 8. Nature, vol. xxxii, p. 555.

[24] Nature, l. c.; and vol. xxxix, pp. 488–492.

[25] Memoirs, American Academy of Arts and Science, new series, vol. vi, 1859, pp. 377–452. Am. Jour. Sci., II, vol. xxviii, pp. 187–200. Gray's Scientific Papers, 1889, vol. ii, pp. 125–141.

loras, and the increasing divergence of prevailing types as
to the equatorial regions and the southern hemisphere, in-
hat in late geologic time the northern circumpolar lands
en united, permitting free land communication, and caus-
same plants and animals to extend throughout the whole
rea. But glacial drift and striæ show that after this a
climate enveloped northwestern Europe, British America,
northern part of the United States with thick accumula-
snow and ice; and I believe that this climatic change was
he increase of the northern elevation of the land, through
he continents had become united. Not only vegetation
seeds upon the glaciated areas must have been destroyed,
the species were mostly preserved by migration southward.
rious species of the preglacial circumpolar flora whose re-
om the European ice-sheet and severe cold was cut off by
enees, Alps, Carpathians, and Caucasus, so that they per-
scaped from extinction in Asia where no general ice-sheet
, and in North America where no transverse ranges of
ins barred their retreat from the ice. The Glacial period is
ut the mild Arctic climate of Tertiary times has not re-

in North America as before noted, and to the extension of the impoverished European flora to the Færöe islands, Iceland, and Greenland, after the vigorous cold and glaciation of these lands had abated. The difference of the plants found on the opposite sides of Baffin bay, presenting a definite break, while elsewhere throughout the Arctic zone they are intermingled as a single continuous flora, with gradual differentiation toward each end, accords with the testimony of the raised beaches of Labrador, western Greenland, and Grinnell Land, with recent marine shells 1,000 to 2,000 feet above the sea, which show that during the Glacial period the Baffin bay region, after having stood much higher than now, as is known by its fiords, sank far below its present level, and during the postglacial epoch has been again uplifted. But the derivation of the plants of the Færöes, Iceland, and Greenland from Europe could not have taken place through the agency of sea currents nor winds, which would the rather favor their coming from America; and therefore botany seems to contribute to geology the proof that the great preglacial elevation of much of the northeastern Atlantic region, unlike that of western Greenland and Labrador, continued through the Ice Age, the spaces which are now sea between Greenland and the British Isles having become submerged, as pointed out by James Geikie, during the Recent epoch, after affording a land passage for the European flora.[27]

Arctic and boreal plants were driven south during the Glacial period to the central part of the United States, and at its close they followed the receding ice-sheet and again took possession of the great northern region from which they had been expelled. With the restoration of a temperate climate throughout the northern United States and southern Canada, the Arctic species found themselves no longer able to survive there, excepting on the cool hights of mountains, notably the White mountains and the Adirondacks, and, in the case of a few species, on the cool, high northern shores of lake Superior and on the adjacent Isle Royale. These stations of Arctic plants are divided by several hundreds of miles from their general northern range; but they all are readily accounted for as remnants of the circumpolar flora which was forced to migrate alternately southward and northward by the climatic changes of the Glacial and postglacial epochs.

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[27] Prehistoric Europe, pp. 518–522, and p. 568, with plate E.

ries bordering the North Atlantic have experienced gener-
mer temperatures than now, both of the sea itself and of
nd winds upon the land, for a considerable time since the
period, apparently extending, but probably in diminishing
nearly to our own day. On the coast of New England
Eastern Provinces, colonies of southern species of marine
s are found in Casco and Quohog bays, Maine, and even in
hern part of the Gulf of Saint Lawrence, such as are com-
ng the warmer shores south of cape Cod, but whose con-
range does not pass north of Massachusetts. These
southern species include the oyster (*Ostrea virginiana*
quohog (*Venus mercenaria* L.), *Pecten irradians* Lam.,
a obsoleta Stimpson, *Urosalpinx cinerea* Stimpson, and
Professor Verrill believes that they are "survivors from
hen the marine climate of the whole coast, from Cape Cod
Scotia and the Bay of Fundy, was warmer than at present,
se species had a continuous range from southern New
to the Gulf of Saint Lawrence."[28] Furthermore, we have
hat oyster and quohog shells are found in abundance in the

But no such evidences of climatic alternations since the Glacial period are discovered in the interior of North America, as in the range of species of plants in the basin of the Red river of the North. Instead, we see there in numerous southern stations of boreal species, indications of the gradual amelioration of the climate through the postglacial epoch to the present day. In Siberia, too, the frozen bodies of mammoths show that a continuously cold but probably ameliorating climate has been uninterrupted by any warm interval since the Glacial period. The recently warmer climate of the northern Atlantic countries, from New England to Greenland, Iceland, Scandinavia, and even Spitzbergen, seems therefore referable to formerly greater volume of the warm Gulf Stream, rather than to any astronomic conditions which would affect not only that ocean and its shores but also the central and northwestern portion of our continent and northern Asia.

The foregoing lines of evidence converge to the conclusion that the cause of the Glacial period was great uplifts of the glaciated areas, probably in conjunction with important changes in the course and volume of the warm oceanic currents. Elsewhere (in an appendix of Wright's "Ice Age in North America") I have endeavored to trace the more remote conditions producing these uplifts, and thereby have accounted, as it seems to me satisfactorily, for the widely distributed areas of Quaternary glaciation, both continental and of mountain districts, for the recurrent advances of the ice-sheets of that time, with warm intervals of recession, and for the far separated areas of glaciation in the Carboniferous and Permian periods.

During the later part of the Tertiary era, and at the beginning of the Quaternary, northern lands were raised higher than now; and the fiords and the submarine valleys indicate that, when this uplifting attained its maximum and brought on the Glacial period, North America and northwestern Europe stood 2,500 to 3,000 feet above their present hight. Alaska and Siberia were probably elevated much less, but enough to supply the continous circumpolar land from which the present community of species in northern floras and faunas is an inheritance. The great area of the shallow Arctic ocean from North America and Siberia to Spitzbergen may have been a land surface, as Mr. Howorth supposes;[30]

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[30] Geol. Mag., III, vol. vi., 1889, pp. 305-8.

deeper portion between Spitzbergen and Greenland would
iterranean sea, or possibly became at length a vast lake,
waters freshened by outflow southward along the remark-
merged Færöe channel. About midway between the
and Færöe islands, this channel is crossed near its south-
nd by the Wyville Thomson Ridge, which consists, at
erficially, of drift with glaciated stones, as determined by
In form and material this appears like an enormous
or coastal bar of shingle.[31]
eröe channel extends from northeast to southwest some
s, with a width of 75 to 100 miles and a depth of 2,800 to
t along its bottom; but the soundings to the top of the
Thomson Ridge are only 1,260 to 1,710 feet, and this
rying from five to ten miles in width, stretches com-
ross the channel. An uplift supplying land connection
nce and Great Britain to the Færöe islands and Green-
h as Geikie believes to have existed, must have exposed
belt of what is now the sea bed on both sides of the deep
annel besides at least the upper part of the Wyville

different parts of the world have doubtless in a general way compensated each other. Apparently while northern countries were being elevated, the extensive coral island area of the Pacific was undergoing subsidence; and recently uplifted coral reefs on the west coast of South America and in the West Indies attest a large amount (2,000 to 2,900 feet) of depression there during some part of the Pliocene and Quaternary periods, extending in Peru at least, and probably in the Greater Antilles, to the postglacial epoch.[33] Several low passes from ocean to ocean are found in the lake Nicaragua region, on the Isthmus, and in the Atrato river district on the south, at hights from 133 to 300 feet above the sea level;[34] and abundant Pliocene fossils, according to Dr. G. A. Maack, occur in the vicinity of the Panama railroad and at many localities southward to the Atrato, ranging in hight up to 763 feet.[35] If these could be referred instead, as seems worthy of inquiry, to the Pleistocene or Glacial period, allowing geologically brief submergence while the great ice-sheets of North America and Europe were being accumulated, the climatic problem of the Quaternary era would be solved.

The sun's heat has probably been undiminished and practically constant. Evaporation from the sea in the torrid and temperate zones was doubtless as efficient during the Glacial period as now. Precipitation from the great storms of that time, sweeping over the highly uplifted continental plateaus, was snow, instead of rain, through nearly the whole year, while the ice-sheets were growing in area and thickness, as Prof. W. M. Davis has stated;[36] and the amelioration of the climate and departure of the ice appear to have resulted from depression of the glaciated areas, while thus heavily ice-laden, and the turning again of the warm oceanic current into the North Atlantic and Arctic seas.

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[33] A. Agassiz, Bulletin of the Museum of comparative Zoology, at Harvard College, vol. iii, pp. 287-290: W. O. Crosby, "On the Mountains of Eastern Cuba," in Appalachia, vol. iii, pp. 129-142. J. G. Sawkins, "Reports on the Geology of Jamaica," 1869, pp. 22, 23, 307, 311, 324-9. W. M. Gabb, Trans. Am. Phil. Soc., vol xv. pp. 103-111.

[34] Charles Ricketts, "The Cause of the Glacial Period, with reference to the British Isles," Geol. Mag., II. vol. ii, 1875, py. 573-580. Thomas Belt, Naturalist in Nicaragua, sec. ed., 1888, p. 35.

[35] Harper's Magazine, vol. xlvii, 1873, p. 812.

[36] AMERICAN GEOLOGIST, vol. v, pp. 122-4. Feb., 1890.

The American Geologist. Dec. 1890

STRUCTURE, CLASSIFICATION, AND AR-
NGEMENT OF AMERICAN PALÆOZOIC CRINOIDS INTO FAMILIES.

By S. A. Miller, Cincinnati.

(CONTINUED FROM NOVEMBER NUMBER.)

ll now briefly define the families based upon the structure
lyx, without, however, undertaking to fully define them
g all the family features that may be discoverable in the
l column.

GENERA HAVING TWO BASALS.

LY, Dichocrinidæ, Cotyledonocrinus, Dichocrinus, Talarocrinus.

alyx is obconoidal. Two basals form a cup slightly
at the sutures. No subradials. Small regular interra-
the truncated top of the first radials. Five, long, radial
the first series; succeeding radials small and resting only
f the upper side of the first radials, the rest being occu-
interradials. Azygous plates in line with the first

FAMILY. Acrocrinidæ—Acrocrinus.

Calyx urn-shaped, composed of plates that increase in size from the basals up. Basals two, comparatively large, forming a ploygonal shallow cup, followed, in Acrocrinus wortheni, by twelve minute, triangular plates all of which are subradial and subinterradial in position; these are followed by twelve larger plates, united by their lateral sides, five of which are radial in position and seven interradial, three of which are in the azygous area; these are followed by a third ring consisting of fourteen plates all of which are subradial and interradial in position except one opposite the azygous side, which is radial in position; a fourth ring consists of sixteen plates, five of which are radial and the others interradial. Above the fourth ring there are two or more radials in each ray separated by interradials, all within the calyx. The number of plates in the calyx of different species varies from 100 to 700. In Acrocrinus shumardi, the type of the genus, instead of four rings of plates, as above defined, there are fourteen or more rings, some of which have twenty-five or thirty plates. Above these rings of small plates there are three to five radials, each series being separated by two or more series of interradials; the azygous area being wider and containing more plates than the others; there are also secondary radials.

The numerous rings of plates, between the basals and the commenement of the continuing series of radials, is peculiar to this genus and family, and, at once, distinguishes it. If the rings were united, they would occupy the position of subradials or subradials and interradials, but such is the arrangement, that we know of no rule, which authorizes them to be treated as if united.

The three families, Dichocrinidæ, Pterotocrinidæ and Acrocrinidæ, having only two basal plates, are widely disconnected, and each one is so far removed from all other families, that no one can be pointed out which is more nearly related to them, or either of them, than another. We can not infer they descended one from another, or that either of them was developed from any particular family of crinoids having three, four or five basals. We may be ever so fond of the theory of the evolution of animals, and the doctrine that embryology reproduces the images of the lines of descent in geological time; but we may stop, when we encounter numerous plates, in the calyx of a crinoid, whose relation and homology with plates in other criniods, we cannot [illegible] discovered, before profess- [illegible] type.

[illegible] SUBRADIALS, [illegible] INTERRADIALS.

[illegible]—Synbathocrinus.

[illegible] the two larger equal, [illegible] No subradials. No [illegible] and thickened [illegible] and between the [illegible] of two or more plates. [illegible] Arms, five, long, [illegible] is composed of five [illegible]

[illegible] Deltacrinus, Haly- [illegible]

[illegible] from the column. [illegible] a single piece, and [illegible] so as to make the

The learning in regard to the respiratory openings in this family is well illustrated by the statement of Wachsmith and Springer, on page 11, pt. 1. of their work, that they had "noted the existence of certain pores or openings located between the arm bases and separated from the arm passages by a thin partition. Their number varies from ten to twenty or more. In Batocrinus where they were most conspicuous, there are twenty, no matter whether the species has more or less than twenty arms. They are about one-third the size of the arm passages, with which they are in very near the same horizontal plane." And the statement, on page 511, pt. 2. where they say, in this they "were evidently in error; the pores probably always agree in number with the arms, and are really neither radial nor interradial, but are placed at the base of the arms."

FAMILY, Platycrinidæ. Coccocrinus, Cordylocrinus, Eucladocrinus, Macrostylocrinus, Marsupiocrinus, Platycrinus.

Calyx subglobose to urnshaped. Basals three, two of them equal, the other smaller, forming a pentagonal disk or cup. No subradials. First radials very large, forming the greater part of the test of the calyx, the upper face of each bears a short or concave facet, for the articulation of the second radials. Second and also third radials, when they exist, small and short. Interradials and azygoin interradials rest upon the first radials and are substantially alike, in the different areas. Column round or elliptical.

In Macrostylocrinus, there are three to five primary radials, and the first interradials are between the second primary radials; smaller interradials occur between the third primary radials, all of which form part of the calyx, below the arms, and, in this respect, it differs from other Platycrinidæ, where the interradials do not connect the second and third primary radials, and approaches the structure of the Actinocrinidæ. It has little structural affinity with the Melocrinidæ which have four basals and to which Wachsmuth referred it. But Wachsmuth disregarded the number of basals to a great extent, in arranging and defining the families, and his definitions are so loose that crinoids belonging to distinct and widely disconnected families may be thrown together in hodgepodge. For example his definition of the Melocrinidæ is as follows:

"Melocrinidæ. Base monocyclic. Basals three to five. Neither anal nor interradial plates touching the basals; the latter ct with radials only. Interradial areas composed of numplates; those upon the dorsal side large, regularly arranged, along the ventral surface frequently small and irregular. ials generally surrounded by proximals. Anus subcentral, n circular rarely angular."

II. Dolatocrinidæ.—Allocrinus, Dolatocrinus, Hadro-crinus, Stereocrinus.

p, basin-shaped or somewhat hemispherical, depressed at se. Basals three, usually anchylosed so as to create doubt the number. No subradials. Primary radials two or three to secondary radials two or more by ten; tertiary radials somepresent. Azygous and regular interradial areas alike. Interrathree or more, the first resting between the upper sloping sides first radials, the larger and generally the largest plate in [illegible] the second interradial which bears [illegible] openings large. Small subcentral proboscis [illegible]

[illegible] the genera, in this family, to the a little narrower at the upper margin, which is on a level with the first radials. Above this plate in the azygous area there are three zones of plates; in the first zone there are six and in succeeding zones seven. Column round. All the plates of the calyx bear articulating spines, the bases of which are perforated with minute circular pits as in the Echinida, and as Hambach determined in some Blastoidæ. This character alone is probably of family importance, as it is not known to exist in any other family of crinoids living or fossil. Otherwise the basals, first radials, and first azygous plate, would ally it with the Actinocrinidæ and the plates above with the Platycrinidæ.

Wachsmuth and Springer classed this family with the Dichocrinidæ and Pterotocrinidæ in one family which they called Hexacrinidæ. There are not three families, in my opinion, farther removed from each other, in all the Palæocrinoida. Their family definition is as follows:

"Hexacrinidæ. Base monocyclic. Basals two or three. First anal plate resting on basals, and similar in form to first radials; other plates arranged as in Platycrinidæ. Calyx with similar arm-like extensions. Column circular."

Let us see what there is in this family definition. 1. They say, "base monocyclic." So is the base in every crinoid that has no subradials. In other families, they include monocyclic and dicyclic crinoids which embrace nearly the whole order. 2. "Basals two or three." This disregards the number of basals as a family character, and, in another part of their work, they say the number of basals cannot be considered as of family importance; and yet crinoids having only two basals are unknown in rocks as low as the Devonian, and Arthracantha is exclusively a middle Devonian genus. 3. "First anal plate resting on basals, and similar in form to first radials." It is the same in the Actinocrinidæ. 4. "Other plates arranged as in Platycrinidæ." Such is not the case in the Pterotocrinidæ, by any stretch of the imagination. 5. "Calyx with similar arm-like extensions." This cannot be true, for they include arms constructed of single and double series, arms widely separated and closely compacted; arms free flowing and those confined in interbrachial angles, and, in short, almost every form is represented. 6. "Column circular." This is the case in nearly every family.

ERA HAVING THREE BASALS. SUBRADIALS. NO REGULAR INTERRADIALS.

**ILY, Ichthycrinoidæ.—Icthyocrinus, Lecanocrinus, Mes-
locrinus.**

yx obconoidal to subglobose. Basals three of unequal size.
dials five, pentagonal and hexagonal. Primary radials two,
r four to five. Secondary radials more or less numerous, and
bifurcating series abutting laterally. No regular interradials.
us interradials usually absent in Ichthyocrinus, one sub-
ngular and resting upon the larger basal as in Mespilocrinus,
, one of which rests obliquely in the angle formed by the
sloping sides of two subradials on the right, and the other
ting the subradial on the left as in Lecanocrinus.

**ILY, Ampheristocrinidæ.—Ampheristocrinus, Clostero-
inus(?)**

yx obpyramidal. Basals three, two truncated on top, the
much smaller and angular above. Subradials five, two
onal, two pentagonal and one heptagonal, the latter the
one. Primary radials one in each series, with a small cen-

genera truncates a subradial, and in others rests between the upper sloping sides and the first radials.

In Taxocrinus subovatus, the basals form a pentagon extending beyond the column, the subradials are small triangular plates separated from each other, so as to allow the first radials to rest upon the basals ot the central part, with under-sloping sides abutting the adjacent subradials.

GENERA HAVING FOUR BASALS. NO SUBRADIALS. REGULAR INTERRADIALS.

FAMILY, Eucalyptocrinidæ.—Eucalyptocrinus, Hypanthocrinus.

Calyx bowl-shaped to obconoidal with depressed base. Basals four, one larger than the others, deeply sunken in the basal cavity and developed in the interior. No subradials. Primary radials three to five; secondary radials two to ten; tertiary radials one to twenty. Interradials three; the first one is the largest plate in the calyx and always has ten sides; the other two are separated by a vertical suture and their upper ends extend to the top of the tertiary radials, where they support long, flat, interbrachial plates; intersecondary radials, in form like the upper regular interradials, in like manner extend to the top of the tertiary radials and support long, interbrachial plates. Azygous area like the other interradial areas. Interbracial plates extend from the top of the interradials as high as the arms reach, where they unite with the summit plates. Column round. After a re-examination of the fossils, I think the genus Hypanthocrinus should be restored to receive those forms with a proboscis extending beyond the arms and summit plates.

FAMILY, Melocrinidæ.—Compsocrinus, Mariacrinus, Melocrinus, Tecunocrinus.

Calyx bowl-shaped to obconoidal. Basals four, unequal. No subradials. Primary radials three to five; secondary radials more or less numerous, and sometimes, as in Compsocrinus, many tertiary radials. Interradial, intersecondary and intertertiary areas more or less flattened or depressed. First regular interradial resting upon the upper sloping sides of the first radials, followed by two plates and these by three, above which the plates are more or less numerous. Azygous area wider than the regular areas, the first plate resting upon a basal or between the first radials, and gener-

llowed by three plates and these by three or four, above
they are more or less numerous. Vault variable. Column
as in Melocrinus, or quadrangular with depressed sides as
npsocrinus. It is not without some doubt that Compso-
is referred to this family, because the azygous side, upper
f the calyx and the column are quite different from all
genera. Technocrinus is also doubtfully referred to this
, because in it, the azygous area is like the other areas, and
per part of the calyx is widely different from Melocrinus.

LY, Xenocrinidæ.—Xenocrinus.

x obpyramidal, sides depressed. Basals four, unequal, unit-
the angles of the column. No subradials. Primary radials
to five, long, flanged on both sides; secondary radials four
e in each series of the same form. Interradial and inter-
ary radial areas depressed and covered with numerous very
plates. The first interradial generally rests upon a basal
some cases it is separated therefrom by a narrow prolonga-
the flanges near the lower part of the first radials, and
rests upon the lower part of and between the first radials.

gous plate resting upon the upper edge of a subradial and between two radials. Column round or pentagonal.

Carabocrinus is included in this family on the supposition that Billings was mistaken in saying the azygous area has three plates instead of one. If, however, his diapnosis was correct the genus would belong to another family.

I have separated from the Cyathocrinidæ the Poteriocrinidæ on the ground of the increased number of plates, and the fact that one of them rests upon two subradials and another upon one; confining the Cyathocrinidæ to those having a single azygous plate truncating a subradial. If this distinction is not of family importance, then the Poteriocrinidæ to those having a single azygous plate truncating a subradial. If this distinction is not of family importance, than the Poteriocrinidæ should be associated with the Cyathocrinidæ, as most authors have done. As a generel rule the calyces of the Poteriocrinidæ are obconoidal from the attachment of the column up, and the bases of the Cyathocrinidæ are sunken, giving the calyces a bowl-shaped, but this rule has its exceptions, so that families cannot be based upon it.

FAMILY, Poteriocrinidæ.—Atelestocrinus, Barrcrinus, Cœlicrinus, Euspirocrinus, Homocrinus, Hydreionocrinus, Poteriocrinus, Scaphiocrinus, Vasocrinus, Zeacrinus.

Calyx obconoidal to bell-shaped. Basals five, equal, forming a flattened disc or low pentagonal cup, with high angles between the subradials. Subradials five, unequal. Primary radials one to five, horizontally truncated upon the upper face for the articulation of brachials. No regular interradials. Azygous interrrdials two or more, the first one resting between two upper sloping sides of subradials and below the under sloping side of the first radial on the right, the second one abutting upon the first, truncating a subradial and abutting upon the first radial on the left. In such genera as Barycrinus, this plate also abuts upon the first radial to the right and extends to the top of the calyx. But in genera having three azygous plates, the third one rests upon the first, abuts upon the second one on the left and the first radial on the right; and if a fourth plate exists it rests upon the second, abuts the upper part of the first radial on the left, and the first brachial, and the third azygous plate on the right. Where three or more plates form part of the calyx, they are arranged alternately in they refer Erisocrinus and Stemmatocrinus to the Cyathocrinidæ, but in the third part they refer them to the Poteriocrinidæ.

FAMILY, Agassizocrinidæ.—Agassizocrinus.

Calyx conical or urn-shaped. Basals five, thick, usually anchylosed, very small internal cavity, in which there are ligamental pitts. Subradials, five, large, thick. Radials two to five. No regular interradials. Azygous interradials, three or four supported upon the basals. In the early stages of life. Agassizocrinus possessed a small column, but in later life even a cicatrix for the columnar attachment is obliterated. I do not use Astylocrinidæ, because it was founded upon Astylocrinus, which is a synonym for Agassizocrinus, and as a generic name falls into synonymy, so does the family name. Wachsmuth and Springer use Astylocrinidæ.

FAMILY, Merocrinidæ.—Merocrinus.

Calyx very low, broad at the base, slighly expanding. Basals five, low, wide. Subradials, five, short, wide. Radials one to four, and one to two, one radial series having two plates, the upper one of which is axillary and supports on its right sloping side a brachial series, and on the left a smaller series that enters into and forms part of a proboscis, and in this respect the arrangement of the plates is like an Iocrinus. No regular interradials. No azygous interradials. Brachials numerous.

GENERA HAVING FIVE BASALS, FIVE SUBRADIALS, REGULAR INTERRADIALS.

FAMILY, Gaurocrinidæ.—Gaurocrinus, Retiocrinus.

Calyx obpyramidal, depressed in the interradial and intersecondary radial areas, and having strong radial ridges. Basals five. Subradials five. Primary radials three to five. Secondary radials from two to sixteen to ten. Regular interradial areas filled with numerous small plates resting upon the subradials. Secondary interradials areas filled with numerous small plates. Azygous area larger than the regular areas, and supported by a ridge up the middle series of plates somewhat like a radial ridge. Vault covered by small plates which are continued as a covering over the arm furrows. Column pentagonal with sides more or less depressed.

FAMILY, Rhodocrinidæ.—Archæocrinus, Goniasteroidocrinus, Lyriocrinus, Rhaphanocrinus, Rhodocrinus.

Calyx subglobose or hemispherical. Basals five, forming a flattened disc or developed as a cone in the interior. Subradials five, equal. Primary radials three to five. Secondary radials one to four to ten. Regular interradial areas wide, plates large, the first one resting upon a subradial and between the first primary radials. Azygous area like the regular areas except an occasional extra plate or two without disturbing the general symmetry of the calyx.

It is not without some doubt that Archæocrinus and Rhaphanocrinus are referred to this family.

FAMILY, Glyptasteridæ.— Glyptaster, Lampterocrinus, Thysanocrinus.

Calyx obpyramidal to cup or urn-shaped. Basals five, equal. Subradials five, four of them equal, the other one truncated for the support of the first azygous plate. Primary radials three to five. Secondary radials variable in number in different genera. Interradial areas flattened or convex, plates large, one in the first series, resting between the upper sloping sides of the first radials, two in the second and smaller ones above. Azygous area wider, the first plate resting on a subradial is followed by three plates and these by three, four or more in succeeding ranges.

GENERA HAVING FIVE BASALS, NO SUBRADIALS, REGULAR INTERRADIALS.

FAMILY, Glyptocrinidæ.—Cupulocrinus, Glyptocrinus, Pycnocrinus, Schizocrinus, Siphonocrinus.

Calyx obpyramidal. Basals five, equal. No subradials. Primary radials three or four to five, the last one supporting secondary radials, and sometimes tertiary radials exist within the calyx. Interradial areas more or less flattened. Regular interradials more or less numerous, the first one resting between the upper sloping sides of the first primary radials; this is followed by two plates, and there are three or more in succeeding series. Azygous area wider and containing more plates than the regular areas, though commencing with one between the upper sloping sides of the primary radials.

I am inclined to think that Siphonocrinus should be classed in another family, because the first plate rests upon the basals, and for other structural differences. It is placed here only provisionally.

Y, Cleiocrinidæ.—Cleiocrinus.

gs described Cleiocrinus as having five basal plates between
radials, and forming a belt at the end of the column. I
ed his illustration in North Americal Geology and Palæon-
Wachsmuth correctly asserts that "such a structure has
een found in any crinoid." I believe with Wachsmuth,
plates supposed to be basals by Billings, are interradials,
nd this I cannot follow him. He believes this genus had
y small basals and five small subradials and he has given
llustration of his views which obliterates the columnar
I am unable to understand why he should suppose
three basals and five subradials when such a structure is
unknown in the Lower Silurian rocks. Indeed, three
five subradials, regular interradials and azygous interra-
known to exist only in three genera, and they belong to
arbonifierous age. I suppose Cleiocrinus had five basals
ubradials. And even with this structure, it would be so
ved by reason of the arrangement of the plates constitut-
alyx, that it would constitute a distinct family.

over the edge of the vault. There is only one genus known. The calyx is low and wide, plates large, column large, different from any other known, arms also differing from all others and bearing pinnules only on one side, from one arm bifurcation to the next alternately.

The diagram of Anomalocrinus incurvus, by Meek in the Ill. Geo. Sur. vol. 3, p 327, and reproduced in my work in North American Geology and Palæontology p. 324, is incorrect, if the specimen figured in the Ohio Paleontology vol. 2 from my collection under the same name, belongs to the same species. The columnar canal is large and five-rayed. The second and third azygous plates form part of the vault covering.

FAMILY, Belemnocrinidæ.—Belemnocrinus.

Calyx cup-shaped. Basals, five, large, long, narrow, and of irregular shape, enclosing a very small visceral cavity. No subradials. Radials one to five, smaller than basals. No regular interradials. Azygous plate like a radial in line with them, resting upon a basal between two radials and supporting a ventral sac.

FAMILY, Catillocrinidæ.—Catillocrinus.

Calyx bowl-shaped. Basals five, forming an irregular pentagon; three of the sides being much the longer. Radials one to five, very irregular in form and size; the two larger ones constitute three-fourths of the circumference at the top of the radials, but are narrow below, while the others diminish in width upward. The arms rise directly from the truncated summit of the radials and are quite compact so that some radials support a much larger number of arms than others do; no regular or azygous interradials.

FAMILY, Hybocrinidæ.—Hybocrinus.

Calyx bulged or tumid on one side. Basals, five, large. One plate half subradial in position, in line with four first radials, but not extending quite so high, and bearing upon one upper sloping side a radial, and upon the other an azygous plate which is rounded and crenulated at its distal extremity as well as much thickened. No regular interradials.

FAMILY, Haplocrinidæ.—Allagecrinus Haplocrinus.

Calyx cup-shape. Basals five. No subradials. No interradials. No azygous plates. Primary radials two to three plus one to two, with small protruding concave facets in the upper

l sides for the attachment of the arms; the upper face
plates supports five vault plates that form a pyramid over
ral cavity of the calyx. The sutures of the vault plates
led, shallow in the lower part, wider and deeper above,
cate the top of the pyramid.

ter regards Haplocrinus as "permanently in the condi-
a Pentacrinoid larva with a closed tentacular vestibule."
uth and Springer, fully agree with him that Haplocrinus
rsistent larval form, but do not understand how the five
tes can represent the orals in a palæocrinoid." Neither
other one. The permanent larval form is equally asburd.
muth and Springer refer Allagecrinus to the Haplocrin-
le Etheridge and Carpenter referred it to the family
nidæ and I followed the latter in my work on North
n Geology and Palæontology; but probably the former are

Y, Pisocrinidæ.—Pisocrinus.

globular. This family has five basal plates, forming a

There is no other American crinoid having basals that form a triangle, nor having five basals followed by a second series of only three plates, nor having a second series composed of plates both radial and subradial in position.

FAMILY, Edriocrinidæ.—Edriocrinus.

Calyx cup-shaped. The base is solid in Edriocrinus, and, therefore, if it ever consisted of more than one plate, the number is unknown, and it constitutes nearly all of the calyx. There are five radials resting in depressions in the base. No regular interradial.. An azygous plate, in line with the radials, rests in a basal depression and extends as high as the radials, it is followed by a small plate. But little is known of this family.

FAMILY UNCERTAIN.

The fossil described by Hall under the name of Myrtillocrinus Americanus belongs to an undefined genus. The definition of the species is probably incorrect, for in all known palæocrinoidea the rays of the columnar canal notch the basal plates, and this species is figured as having a four-rayed canal and described as having five basals. Probably other specimens will show that it has only four basals, for otherwise, it will be quite anomalous, and in either event, it is not a Myrtillocrinus.

Nipterocrinus was placed by Wachsmuth in the Icthyocrinidæ without knowing the number of basals in the genus, and Zittel referred it to the Cyathocrinidæ upon equally as good grounds. Until we know whether it has three or five basals, any family reference must be provisional and of little value.

Camarocrinus doubtless belongs to a family Camarocrinidæ, but it is so far removed from other crinoids that it may belong to a distinct order. Ancyrocrinus, Aspidocrinus, Brachiocrinus, Coronocrinus, Cystocrinus and Pachycrinus are genera about which very little is known.

A GREAT QUARTZYTE MORE RECENT THAN THE OLENUS-SCHIST.

By N. O. Holst.*

While the author was reconnoitering in the southern part of the district of Vester-botten in 1885, he observed also the exposures of

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*From Geologiska Föreningens i Stockholm Bd. II, p. 33, 1889. Translated by O. W. Oestlund.

an along Ormsjö (a lake) in the parish of Doratea, as
made known by E. Sidenbladh. The Silurian strata con-
m this point further northwest along the valley of Orms-
observed by me last fall. Thus were seen slates contain-
ten" belonging to the horizon of Paradoxides forchham-
ew kilometers south of Bredsele on Arksjöån, as well as
outheast at Nyboden. At the first named place were
gnostus lævigatus Dalm.,[1] A. planicauda Ang., as well
ies of Olenus and possibly still another species of Agnos-
he latter named place, Agnostus planicauda Ang. and
also A. fallax Linrs.

cial interest are the geological relations at the rather
untain, Månsberget, situated two Swedish miles north-
he Doratea church. Below this mountain a small boulder-
plain extends down towards Öster-ormsjö, which covers
of the mountain. Somewhat further towards the north-
se to the shores of Ormsjö, at the village Vester-Ormsjö,
an slate is, however, seen to predominate so largely in

At several places it can also be seen that the slate and the "orsten," as found in the slope, have about the same dip as the quartzyte. The Silurian deposits here are, without any doubt, connected with those just mentioned at Vester-Ormsjö.

Already in 1885 I made the observation in connection with my visit here "that the slate to all appearance was over-laid by the quartzyte." But I did not wish then altogether to exclude the possibility of the slate being deposited cotemporaneously with the quartzyte, or by faulting had got a lower position in relation to the quartzyte than what it originally had. Although an extensive landslide covers the slope in which the slate is found, yet the slate and the quartzyte came so close together that I already at that time perceived that the true relation of these two rocks could readily be made out, and without very extensive digging.

Fig. 1.

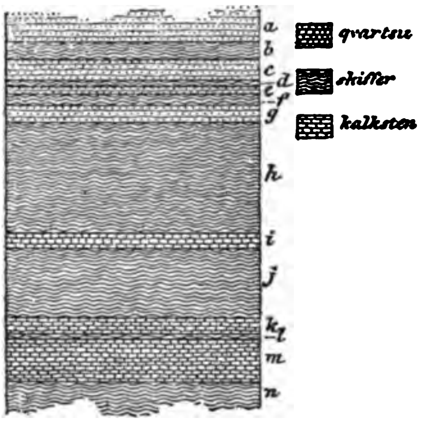

FIG. 1.

a. *quartzyte*, dipping 15° west, continuing up the mountain. *b.* black, soft *schist*, here and there with thin bands of harder, greenish schist, 0.6 m. *c.* *quartzyte*, much broken up into irregular pieces, like *e*, somewhat like "grauwacke," 0.7 m. *d.* dark *schist* (equals *b*), 0.2 m. *e.* bedded, greenish *quartzyte*, much broken, both in large and small pieces. 0.3 m. *f.* dark *schist*, 0.4 m. *g.* a compact layer of *quartzyte*, much broken, 0.6 m. *h.* black, nearly pure *schist*, 4 m. *i.* a layer of limestone, containing "orsten," with *Olenus*, probably, *O. gibbosa* Wahlenb, 0.5 m. *j.* "grauwacke" *schist* (somewhat harder than the higher black schist), 2.5 m. *k.* a layer of limestone with *Olenus gibbosa* Wahlenb.,[1] 0.6 m. *l.* "grauwacke" schist, 0.2 m. *m.* a layer of limestone, 1.4 m. *n.* "grauwacke" schist.

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[1] Specimens from this layer are smaller than those from layer *i*.

hat time I passed the place late in the day, and did not e to return the following day.

fall, when I again passed through the valley of Ormsjö, d to make out the relation of the strata by digging, and rised when I found how easily this could be done. The hus obtained is herewith presented.

late is often compressed but appears in general to dip in direction as the quartzyte. Furthermore, it may be at layers of black slate a few decimeters in thickness are he lower part of the *quartzyte* (a), which reminds one of the Olenus slates.

ratigraphic relations at the Månsberget, therefore, give tions of *a great quartzyte deposited above the Olenus* and even seems to pass into it by an alternation of layers.

T OBSERVATIONS ON SOME CANADIAN ROCKS.

BY ALEXANDER WINCHELL, Ann Arbor.

in Murray's footsteps without receiving an impression of his tireless energy and his quick geological intuitions in working out the structure of regions difficult, as these are, in the extreme.

The whole of the country over which my recent observations extended, is colored by Sir William Logan as Huronian, and reaching from the uppermost quartzites to the "Lower Slate Conglomerates."

The Ste. Marie's river from lake Superior to the head of Great Lake George, pursues a direction a little north of east; but it presents two northward curvatures shaped like an ox-yoke, in the centre of the western of which, the two Saults—the Canadian and the American cities—are situated, and the centre of the eastern of which swells into Little Lake George. Great Lake George is a broad expansion of the river opening out of the eastern extremity of the ox-yoke, as Hay lake opens out of the middle of the ox-yoke—the two forming opposite sides of Sugar island. The immediate Canadian shore of the river Ste. Marie is mostly level and sandy, and without doubt, is underlaid by the lake Superior sandstone, which outcrops at the Sault and in the neighborhood of Gros Cap of lake Superior. At the distance of one or two miles back from the shore, the country becomes rugged, through the presence of successive short ranges of quartzite hills, rendered more pronounced, in many cases, by dykes of diorite and felsite. The quartzite ranges are separated by valleys of hard timber and a fertile soil; and these, within twenty miles of the river, are cleared and cultivated. These ranges continue to the east and southeast of the head of Great Lake George, with a general easterly trend; but, at a greater distance, their trend is more southeasterly; and the entire peninsula between Great Lake George and the "Northern Channel" is occupied by them, as far as the Bruce mines and the Thessalon river.

One who has studied the Huronian quartzites in the valley of the Thessalon, will at once recognize their prolongation in the region east of Great Lake George. Between Ottertail lake and Echo bay is only fifteen miles in a straight line, and in the direction of the strike; and the great white pebbly and reddish quartzites have undergone no perceptible change. It is not necessary, therefore, to give them a full description, in this place. It suffices to state that in the district referred to, they assume a very massive condition, the beds when discernible, being four to eight

:k, and outcropping in a succession of terraces—as occurs the Thessalon valley. But considerable search is requisite ver either outcropping steps, bands of deposition or dis- ırses of pebbles—the last, though of frequent occurrence, enerally disseminated through the rock.

other remark which may possess interest, concerns de- f iron ore in the quartzites. The terrane is extensively in- l by veins and joints. A system of jointage trends nearly l west, and none of these joints assume the character of But there are many veins and quasi-veins trending and N 65° W, which carry encouraging quantities of e. As regards the filling of these veins, there are two The first class consists largely of a network of veinlets gangue, diverging and reuniting with a principal vein. ter, however, has not been seen to exceed four or five n diameter; and the whole network, spreading sometimes, pace ten or twelve feet wide, would scarcely aggregate two 'he whole contents of the system of ramification is pure, rd and brilliant, hæmatite.

undoubtedly hæmatite, since a deep red color is developed in grinding the thin sections. This gangue fills the vein-fissure somewhat homogeneously from wall to wall, without any indication of a comb structure.

This substance is in process of change to hæmatite, or perhaps more properly, replacement by hæmatite, though the processes wonderfully simulate transmutation, to the ordinary observer. It begins on the surfaces of joints or fractures, and penetrates into the solid interior. In many places it has proceeded until large masses of hæmatite have been formed. This is occasionally limonitic, but generally, a rich quality of hæmatite, often black and solid. The boundary between the changed and unchanged portions is generally abrupt. The portion immediately contiguous to the hæmatite is not distinguishable from the general unchanged mass. The conviction arises that in course of time, the entire gangue would become iron ore. The change witnessed is of course, within a few feet of the surface; but it does not appear to what extent it depends upon meteoric agencies; nor whether the amount of change accomplished would increase or diminish with depth.

In one location a width of eighteen feet appeared to have completed the change, though in this case, the soft red material contained only about eight per cent. of iron. Along side of this, however, was a rich, vein-like deposit of hæmatite, in places almost specular in its lustre. It may be suggested that the rich vein-like accumulation in the kaolinic substance, or along side of it, has been derived from the numerous minute hæmatitic particles disseminated through the gray mass, and that the reddened mass is the same after most of the iron has been extracted.

In another instance, the kaolinic gangue material extended over a breadth of fifty or sixty feet, though the soft argillaceous iron deposit was but a few inches wide. The ore is coarsely granular, and the grains possess flattened sides as if by mutual pressure. In spots, the pressure has been accompanied by slight motion which has imparted a slaty structure. The kaolinic mother stuff is similarly granular, and similarly slaty in places. The color of the stuff is pale bluish. The completed change is found to progress from point to point, and a distinct limit is quite conspicuous. In some portions the change is complete, except an island of the greenish gangue, which is thus surrounded on all sides by the completed ore.

urious deposits appear to occupy fissures in the quartzite,
mited by walls fairly distinct, and trend in fixed direc-
5° W and N 65° W. There are no indications of an
either in disturbance or metamorphism. It is not easily
le that these deposits should have resulted from any
dition of irruptive or volatilized matter. It is equally
o conceive of its origin from the quartzite, either by
n or decay. Nor is the case clearer if we apply the
s of infiltration. I am not sufficiently acquainted with
terature at large to say whether the occurrence is ex-

r mode of occurrence of hæmatite in the Huronian
is in association with diorite dykes. In one instance, a
ing N 20° W, and having a width of 400 feet, and com-
long, smooth-faced crystals of hornblende, with a red
e, is accompanied by narrow, irregular veins of hæma-
e hæmatite is associated with red jasper mostly in the
of parallel laminæ of not over an inch in thickness. I
ble to ascertain, with facilities for research at disposal,
the iron and jasper are included in the diorite, or are

Echo Lake.

Having received oral information concerning the rocks about the head of Echo lake, which produced a half-formed conviction that they are older than the Huronian, I followed the quartzites northward from Great Lake George, across the strike, with unusual interest. The Echo river flows for about four miles, in a serpentine course, across the level and partly swampy border which separates the hilly interior from Great Lake George. No rocks are seen to outcrop along the banks, and it is obvious that the country formation is no longer quartzite. According to Murray, a "slate conglomerate" is seen both on the east and the west of the lower portion of Echo lake, at distances not exceeding two or three miles, and beyond. But, I found, about a mile north of the foot of the lake, evidently at a lower horizon than the slate conglomerate proper, a quartzose range, attaining an elevation of about 250 feet, and traversed by ramifying veins of hæmatite. From a shaft sunk to the depth of about 30 feet, it appears that the formation is in part, a silico-argillaceous slate, and in part a fine grained and semi-vitreous smoky quartzite. Lithologically it is quite distinct from the white or reddish vitreo-granular quartzite further south, and marking the upper portion of the Huronian. It occupies the position of the lower part of the "upper slate conglomerate" noted by Murray and mapped by Logan. On the west shore of Echo lake, within a third of a mile of Limestone point, is an outcrop of dark gray, very fine or vitreous quartzite, which may be an eastward prolongation of that last mentioned. It is not very unlike the flinty quartzite which I have heretofore designated the "Missisagui quartzite" * and supposed to be the lowest member of the Huronian on the Missisagui river. But I do not announce here such an identification. That would necessitate a reconstruction of Logan's map.

A short distance beyond this is the point formed by the outcrop of a bed of limestone. It stands *vis a vis* to another point on the east shore—the bearing from one to the other being S 75° E. The distance across the point, representing the width of the outcrop, is about 330 feet. The beach slope of the exposure covers about 30 square rods; and the surface is amazingly, almost grotesquely, rough, the salient ridges of the more durable laminæ standing out one or two inches above the general surface, being inclined with ınd crumpled in an almost incredible fashion. Freshly ırfaces of the rock reveal lighter and darker, tortuous, lel bandings; but the difference in durability of different vould hardly be suspected. The formation on the whole, y silicious limestone, very hard, fine grained, with ine light and dark dun laminæ alternating, and presenting fracture, a handsome appearance. A vertical dyke of ed, black dolerite intersects the formation, 4½ inches iking N 60° E, with a joint running longitudinally along le. As to dip and strike of the limestone, the observa- various. The dip ranges locally from 10° up to 45°; ncluded that the average dip is not far from 20°; and I pt this as the dip of the Huronian at this place. Such ccordant with many observations made on the quartzites n the series. The direction of the dip here is about

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* *Sixteenth Annual Report Minnesota*, pp. 167–170.

ıtcrop on the east side of the lake is about 500 feet wide. is somewhat less hard. Where blasted into for testing y, it is very compact and fine grained, and in places, delnted. The bands are not conspicuous except on weathproaches within a mile of Little Lake George. Its banded features are here quite conspicuous. A Chicago company has opened a quarry, and is carrying on somewhat extensive operations. The polished surfaces of the banded and of the tinted portions constitute varieties of handsome marble—not clouded like some of that from Vermont, but softly ribboned, and very fine and delicate in texture, and procurable in large blocks.

This limestone does not fully resemble that which I have examined in the vicinity of the old Bruce Mines, with which Murray supposed it a continuation. On Logan's map, it is not connected with the Bruce limestone; though the separation was supposed due to a fault existing along the valley of the Thessalon. But I hold in reserve my opinion respecting their identity. It more resembles the cherty limestone occurring in the vicinity of Ottertail* and at Ansonia**—perhaps Logan's "3k, Yellow chert and limestone," embraced in the quartzite series, and holding a position *above* the "upper slate conglomerate"—not below, as here. This though in places cherty, possesses the fineness and evenness of texture of a lithographic stone. At the Ansonia outcrop, its attitude is disturbed by a dyke of diabase; but it presents the same delicate ashes-of-roses and creamy tints** as on Echo lake and at the quarry near Garden river. The formation at Ottertail dips 28° toward S 58° W, and this amount of dip may be said to characterize the members of the Huronian generally, from the mouth of the Thessalon to Echo lake.

The resemblance to the Ansonia and Ottertail limestones is fully borne out by microscopic characters. The Ansonia rock contains more silicious particles, and a little more disseminated dust of decomposition. But a striking resemblance is seen in delicate argillaceous lines of deposition, and the formation of darker bands, while the general aspect of the one is a faithful picture of the other. At one point, however, the Ansonia limestone is formed largely of rounded calcitic fragments, crossed by very numerous cleavage cracks; and in this condition, some larger grains of quartz are also enclosed. But these comparisons will be pursued on a later occasion.

The very probable identity of the Ottertail, Ansonia and Echo lake limestones must therefore be considered, in spite of their ap-

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***Sixteenth Annual Report* of Minnesota Surv., p. 158.

****Sixteenth Ann. Rep.* Minn. p. 155.

lifferent relations to the "upper slate conglomerate"—
r appearing to hold a place *above* the "upper slate con-
," and the latter now certainly holding a place *below* it.
on determined for the former—not to speak of Logan's as-
of it to the same horizon—was based by the writer,* on
sed existence of a fault which had elevated it nearly to a
the summit of the upper, or white quartzite, while the
of pebbles of this cherty limestone indicated a position
lower or red quartzite—some 9,000 feet below its actual
t Ottertail. There was nothing known then, to indicate
d been uplifted from a still lower level; but, if the Echo
tone be its equivalent, the uplift must have been from a
w the "upper slate conglomerate"—that is, an uplift of
t, according to my observations of the thickness of the
slate conglomerate." So far then, as the petrographic
of the Ottertail and Echo lake limestones is admitted in
we have reason for changing the recorded position of the
limestone—the "3k Yellow Chert and Limestone" of
This change would bring it into the position of Logan's
estone," immediately below the "upper slate conglom-

the Huronian. The talus of the high hills is made of fragments of hard greenish and blackish slates, not hitherto seen in the Huronian, and among them are huge fragments which lithologically answer the description of the slate conglomerate of the east and north shores of lake Superior. The dips are all very steep. Still further on, is a mass of felsitic quartzite. Beyond this, and northward from the head of the lake, I found a succession of reddish and felsitic quartzite, sericitic quartzose schist, and many fragments of hard slate conglomerate, unlike the "upper slate conglomerate" of the Huronian—the slate being here of a dark, greenish color, considerably warped and twisted, the pebbles ranging from partly rounded to completely smooth, mostly reddish with feldspar, and containing some quartz. Near this, at a higher level, the slate conglomerate is seen in place, very rugged in aspect, standing vertically and striking east and west. It has much the aspect of the Ogishke conglomerate of Minnesota. Still beyond, and at higher levels, we find felsitic quartzite standing vertical and striking N 75° W and N 60° W. On the summit of a hill about 400 feet above Echo lake, the vertical knotted serico-argillitic schist is woven into meshes by half-inch thick quartz veins. Near here are outcrops of hæmatite. Vertical strata of similar character continue growing less conglomeritic and more sericitic; but pebbles do not wholly disappear, and now lie in courses N 55° W. A little beyond, the slate becomes argillitic, and the formation now closely resembles the Ogishke conglomerate. The country varies by turns to more argillitic and more sericitic and more conglomeritic, intersected occasionally by diorite dykes, until we reach the highest summit, where a bed of interstratified hæmatite appears, beyond which, crossing a valley, we find a rugged hill of vertical, dark, slaty argillite—the exact counterpart of the Knife lake argillite of Minnesota. The course of this traverse is directly north from the head of Echo lake, and the air-line distance about a mile.

These changed rocks, in attitudes so strange, cannot belong to the same system with the quartzites, the upper slate conglomerate and the limestone of the Huronian. These rugged strata stand vertically; the Huronian beds dip at an angle of 20°. These rocks strike east, or in a direction approximating that; the Huronian beds strike mostly NE and SW, though with many local variations in these parts. Here is a genuine discordance of strati-

Here are two systems, and not one, as Sir William
s mapped them.

es of convictions now becomes rather clear. We stand
he veritable formation which, sweeping back of Gros Cap
s bay and Doré river, was identified by Logan, with the
of lake Huron, and fully described in terms which apply
to the rocks here under investigation. We are con-
lso, of their identity with the vertical strata in Minne-
the Canadian Northwest, known as the "Kewatin" sys-
e same observer brings the facts from remote points
tal juxtaposition, and seems to be in a position to certify
arallelism.

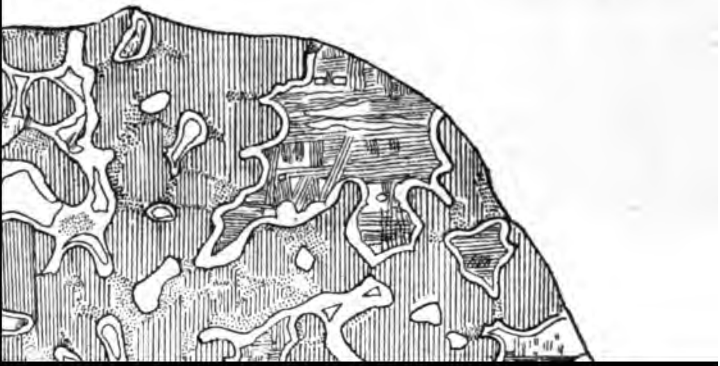
e same time, another conviction seems equally clear.
rled, green and pebbly slates are the prolongation of the
Slate Conglomerate" of the Thessalon valley.

h here a question of such fundamental importance that
nt occasion will not suffice for its discussion. The out-
been a surprise, and I desire to pursue the subject at
pportunity.

rbor, Nov., 1890.

an average depth of about two inches, fading out gradually toward the center and being replaced by the unchanged olivine, is not well shown, but on examining the natural specimen any one is impressed with the great change that has taken place in the mineral, and the great interval of time that must have elapsed since the specimen came within the influence of our atmosphere.

Since the specimen was cut, and while this slab has been exposed to the atmosphere of our office where no acid fumes could have reached it so as to hasten the process, there has taken place a noticeable oxidation all over that part of the cut surface which contains the fresh olivine, viz., about the central portion, and the metallic iron has become rusted to such an extent that it presents a strong contrast with the metallic iron which is nearer the periphery of the slab. This points directly to the nature of the change which has taken place in the meteoric mass. It indicates the loss of some easily oxidizing mineral originally present throughout the mass, or at least its partial conversion into some acid that rapidly attacks metallic iron. On making a closer inspection it appears that the source of this rusting agent is not in the bronzy sulphide mentioned as one of the evident minerals. The red iron-rust surrounds and adheres at the edges of the metallic areas, and even stands up in blisters or minute bubbles, even where none of the bronzy mineral is present. The bronzy mineral is still perfectly fresh generally, and is equally fresh and abundant in the darkened periphery where the change has been carried to completion. In some of the cavities within the spongy iron, from which the olivine amygdules have been dislodged by the process of cutting the specimen, may be seen the thin black film to which we have alluded as giving the iron matrix a botryoidal and specular reflection, and having, when fresh, a silvery metallic lustre, and a hardness of about 3 or 3½. It appears to be this film which furnishes the rusting agent. Some of these films are partially coated with red blisters of iron oxide, although depressed below the general surface and out of the reach of fumes that might have originated elsewhere; they are now either rusty or tarnished or blackened, having lost the bright silvery reflection. In the peripheral portion, however, where the change was so gradual that nearly all the products of the alteration were retained *in situ*, these separating films still present shining surfaces wherever the olivine grains have been removed. The irony product of this alteration seems ave entered in the peripheral portion into some of the the olivine, turning them opaque black but not render- serpentinous. This was accompanied by a proportionate me of the magnesia, as shown by the chemical analyses This rust on the iron is not the result of simple atmos- idation, but has the appearance of iron that has been rroded by some acid, and it indicates that the sulphur in s is in a different state of combination from that in the ineral.



For the purposes of analysis three portions of the meteoric mass were selected, namely: first, a portion of the metal; secondly, a portion of the light-colored non-metallic substance; thirdly, a portion of the dark-colored non-metallic substance. These portions were each picked out from a mixed mass of fragments and cuttings obtained in the process of making sections of the meteorite by sawing.

1. *Analysis of the metallic portion.*

Iron	90.48 per cent.
Nickel	8.59 " "
Cobalt	.16 " "
Copper	Trace.
Phosphorus	.27 " "
Sulphur	.05 " "
Carbon	Trace.
Silica	.24 " "
Chromic Oxide	.09 " "
	99.88

The silica and the chromic oxide were found in the residue left on dissolving the metal with nitro-hydrochloric acid. The chromic oxide was in combination with a small amount of iron, as chromite. This, as well as the silica, may have been attached to the surface of pieces of the metal, although pains were taken to remove all such attached matter before analysis. A determination of carbon was undertaken, by Weyl's method. The small amount of residue from the process of solution resembled carbon. But when tested qualitatively, by ignition on platinum foil, only a small part of this residue was consumed.

2. *Analysis of the light-colored non-metallic portion.*

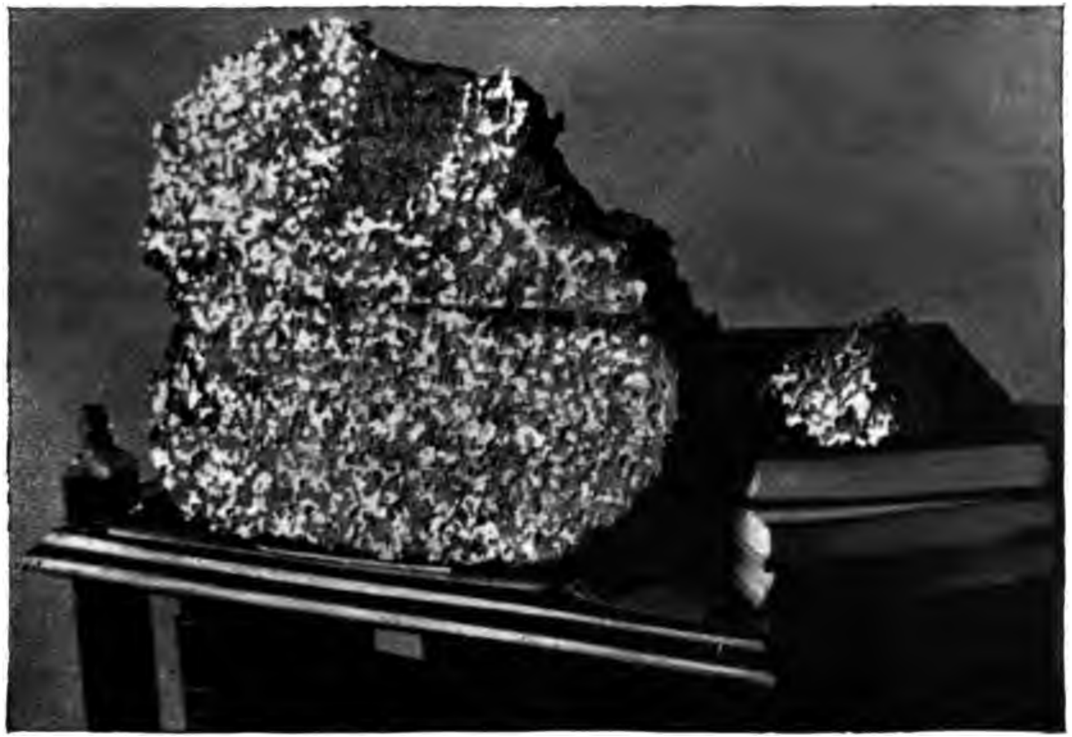
Silica	40.50 per cent.
Ferrous Oxide	10.51 " "
Ferric Oxide	1.77 " "
Magnesia	47.18 " "
Phosphorus	Trace.
	99.96

The chemical composition of this portion is evidently that of olivine.

3. *Analysis of the dark-colored non-metallic portion.*

This portion appeared in some respects the most interesting. The pieces selected for analysis varied in size from about one-twentieth to about one-fourth inch in longest diameter. They were of irregular shape, but mostly with rounded surfaces, as broken out of the cellular spaces in the metallic part of the meteorite. Their material appeared to be homogeneous. They

of nearly the same color, almost black, surfaces of frac-
ving a brilliant lustre. Some were slightly attracted by a
The powder had a dark grey color.
rming the powder with moderately strong hydrochloric
tial decomposition took place, with separation of silicic
evolution of sulphuretted hydrogen in small quantity.
ve analysis showed the presence of sulphur, silica, iron,
chromium, magnesia and phosphorus. None of the
n passed into the solution made with hydrochloric acid.
antitative analysis, after digesting the powder with hy-
c acid and evaporating to separate silica, the insoluble
amounted to 44.3 per cent. This residue had a grey
ch as might be produced by making a mixture of silica
dered chromite; and this it undoubtedly was. The
oxide and the iron in this residue were found to amount
ely to 12.28 and 4.68 per cent. This iron is slightly
of the quantity required by the formula $Fe\,O.\,Cr_2\,O_3$.
of this is taken in the following statement of results. A
ation of the total ferrous iron present in the powdered
e was undertaken, by the method of professor Cooke.



KIOWA COUNTY, KANSAS, METEORITE.

[Original mass weighed 211 pounds.]

As regards the distribution of the iron in the foregoing statement of the results of the analysis, it will be observed that certain assumptions are made. It was, of course, necessary that *some* assumptions should be made. The foregoing arrangement of the results indicates the presence in the material analyzed of four minerals, namely: first, a silicate of composition like that of olivine altered by the higher oxidation of a part of the iron, this mineral making up 74.42 per cent. of the whole; secondly, chromite, amounting to 18.31 per cent. of the whole; thirdly, triolite, 4.76 per cent.; fourthly, schreibersite, 2.13 per cent.

Yet, as previously stated, the material appeared to the eye homogeneous, and a mechanical separation of the above named minerals from the portion taken for analysis would probably have been impossible.

The oxidation which has been mentioned as taking place while the slab has stood in a room at ordinary temperatures, and which seems to indicate the presence of a sulphide besides that of triolite, throws additional light on the probable nature of the minerals that are present, and particularly as to the presence of daubréelite, a sulphide of chromium; and it is here suggested, for future investigation, that the profound change which has taken place in the mass may consist in a conversion of daubréelite to chromite, in the same manner as sulphides of iron are sometimes converted *in situ* on a large scale to oxides. In that case it will be found that the scale which lines the cavities within the iron, in the interior of the mass, surrounding the olivine masses, is a sulphide of chromium, probably daubréelite, * but that in the periphery which shows no accumulation of iron rust since cutting, this scale consists almost entirely of chromite.

The existence of daubréelite as a possible antecedent condition of some of the chromite must remain, for the present, wholly speculative, and the presence of schreibersite is dependent on the necessities of the chemical contents and formulæ.

Microscopic Examination in Thin Section.

We have examined six thin sections. We can detect in them but three minerals, viz:

1. *Olivine*, as indicated by the analysis. This shows all the usual characters of olivine, except that some of the grains do not

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*C. U. Shepard described what he considered a sesquisulphuret of chromium and named schreibersite, but daubréelite has superseded it.

light.

2. *Chromite.* In making the selectio
dark, non-metallic portion, it is plain that
of this mineral was included. It is foun
dark periphery of the slab, but within the
in both cases it is shining black (like antl
fracture and imperfect cleavage are not ea
those of the olivine, but it lies in the mid
grains and does not show any tendency
presenting sharp transitions. It is enti
reflected light its surfaces, in the section,
with numerous particles of troilite.

3. *Troilite.* Throughout the meteori
the thin sections, are megascopic particle
brassy mineral which is that characteristi
forms not only individual masses, someti
of an inch in diameter, but surrounds an
olivines. It is opaque, but its ground su
seem always to be checked and rough
fracture.

It will be noticed that our results diffe
Mr. Kunz: whereas the analyses given b
of a small amount of manganese oxide a
analyses indicate the presence of a consid
mium, and his show none. He also spea
"break out entire, the faces on many
enough to measure the angles. The spac
are highly polished, showing every crysta
polish." We find our olivine masses in r

iron had been made use of by the aborigines, or the mound-builders, as pieces of meteoric iron have been found in the mounds of the Ohio valley.

THE GEOLOGICAL SURVEY OF NICARAGUA.

By J. Crawford, Managua, Nicaragua.

Writers referring to the geology of Nicaragua invariably follow the Spanish statements of the fifteenth century; and declare it to consist of a heterogeneous mixture of materials ejected from volcanoes, like that of other countries of Central America. Its natural history has never been specially examined. This is particularly true of its geology. Two former attempts have been organized for this purpose, but never actually commenced work. This was the situation when, about two years ago, I was leisurely passing through Nicaragua by the usual route from Corinto on the Pacific coast to San Juan del Norte (now America) on the shore of the Caribbean sea. Seeing several rocks and minerals that had been found here, which caused me to doubt the correctness of opinions heretofore entertained, I rather gladly accepted the offer from the Nicaraguan government to superintend for it the collection of specimens of its natural history for exhibition at Paris. To this duty it was soon agreed to add that of examining and reporting on the geology, mineralogy and botany of this country.

The government of Nicaragua gave me the use of the very few instruments it had suitable for my work, also such scientific books in the national library as I might find useful for reference. These books I found to be very antiquated editions of some of the works of Murchison, Lyell, and De Candolle, and some recent publications of Dana, J. P. Cooke and J. H. Wythe. The latter books have been my sole intelligent companions during the greater part of the past twenty-two months.

The belief that Nicaragua was almost all formed from volcanic ejecta was too firmly rooted to warrant the expenditure necessary for an outfit of modern apparatus, instruments and books. We knew that about one third part of the country was occupied only by wild animals, and by the small remnants of three tribes of semi-civilized aborigines, and that the other third part was, outside of a few towns, sparsely settled by miners, cattle rancheros and Indians. Consequently I expected a very rough time, in a moun-

tions, whi [redacted]
wardly through Qua y, Tertiary, Mesc
eras. These in some places showed evic
affected by volcanic forces, or streams of
these, with possibly Devonian and Silurian
Eozoic rocks, as bare and bald to the sun a
Labrador. My excavations were necessari
but they revealed evidence of the existen
wealth of paleozoic fossils that will, when
care, delight the hearts of the future paleo
For twenty-two months I have been act
daily in examining mountains, hills, defile
soils, etc., ruins, springs, flora and fauna,
to enable me to make out a general descrip
Nicaragua.

Nicaragua, geologically considered, is div

Section First.

This is the volcanic region, the materia
and from Quaternary age. They consist
tufas, bombs, breccias, ashes and volcanic
a cement. There are here also Mesozoic a
and minerals, which have been displaced,
changed in appearance by volcanic forces.
ward and southwestward, extending to the
Costa Rica. It has a tortuous line,
13° 15′ N. and long. 87° (west from Gre
to about lat. 11° 10′ N. and long. 84° 1
large lakes Managua and Nicaragua (once
ocean) and many other lakes which occ

plains composed of large and small pieces of igneous rock mixed and hardened with a large quantity of argillaceous sands and volcanic ash. It also embraces wide valleys from 25 to 100 feet in altitude above the Pacific ocean. These are formed in strata, in descending order of,

1. A slightly compacted mixture of vegetable mold and fine-grained volcanic cinders and ashes, from 5 to 15 feet thick.
2. Calcareous materials from two to three feet thick, loosely compacted, or hard, composed largely of remains of shells and crustaceans, some of them being lacustrine and others of brackish-water species, but a large majority of marine.
3. A hardened mixture of sharp-angled igneous rocks, lavas, sands, cinders and ashes, of a depth not yet ascertained, but very deep.*

In this section sulphur (sofatares), paszulano, pumice and obsidian are abundant, and gold, iron ores, lignite, concrete, anthracite are found in some quantities. The anthracite is supposed to be formed by heat from lignite.

The lands in this section are very fertile, and during the rainy season capable of producing large crops. On the elevated plains, 2,500 to 3,500 feet above the Pacific, Ixorea coffea, Cinchonea and other rubiaceous plants are found to perfection.

The following is the approximate altitude of some volcanoes and lakes in this section.

Volcanoes.	*Lakes.*
Viego, 6.160 feet.	Managua, 143 feet (fresh water).
Momotomba, 6.510 feet (smoking)	Tiscapa, 176 feet. "
Caseguina, 3.860 feet.	Nijapa, 168 feet (saline).
Masaya, 3,800 feet.	Giloa, 138 feet. "
Mombacho, 5.100 feet.	Masaya, 415 feet (fresh).
Ometapa, 5.800 feet (hot on top).	Apoyo, 785 feet. "
Madera, 5.000 feet.	Nicaragua, 126 ft. (slightly saline).

None of the volcanoes are active at present. Momotomba emits a little vapor, and is hot on top. Ometape is not quite cool on top, and a rough murmuring sound is heard at its base, becoming now almost inaudible from a very distinct and disagreeable, continuous, grating noise heard there for several months in the latter part of 1887. The water in the lake Nijapa is strongly impregnated with salts, so that a light, copious lather is formed on the heads of persons bathing there. The water of lake Nicaragua

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* Also at different depths from the surface are deposits like beds of glacial drift, generally found, at intervals, from a few leagues northwest of lake Managua westward to the Pacific ocean.

sufficient percentage of chlorides, etc., to agree with
dæ, whose teeth are not so lance-shaped as are the
ecies. The water in lake Managua contains a much
r centum of saline matter than lake Nicaragua, but more
le the per centum of salts in the waters at the mouth of
iejo which empties into this lake. Large springs of
neral waters are found in the valley near the western
motomba, also below the falls at Puebla Tipitapa, on
ide of the channel, also on the north side of San Juan
containing a large per cent of sulphur, iron, magnesia
es. Mud-floods ("aluvions") have occurred in this
d sometimes the resulting stratified formation resembles
eds of the Tertiary so closely as to be very deceptive,
very careful examination to be distinguished.

Second Section.

ision adjoins and is northeastward from the last, and
a northeast direction to a line from about lat. 13° 25′
g. 86° 50′ W. to about long. 86° 35′ W., thence to a very

In this section are many large valleys 250 to 750 feet above the Pacific ocean, some of them well watered, but the majority not well watered. It also contains many forests of valuable trees. The average temperature is about 22° Cent. The fact that this section adjoins the great volcanic belt on the southwest, and the Archean area and Silurian formations without volcanoes on the northeast, causes much perplexity when examining about its margins or limits and in describing it even in a general way; especially to distinguish between metamorphism occasioned by heat from volcanic sources, and that by heat developed on the attrition of particles from contraction.

Section Third.

This section adjoins and lies to the northeast of section second, and is bounded on its northeastern side by a line northeastwardly from about lat. 13° 25′ N., and long. 86° 40′ W., to lat. 14° 42′ N., and long. 84° 40′ W., thence southeastwardly to about lat. 12° 40′ N. and long. 84° 30′ W.

1. Gneiss, granite, protogine, porphyry, slates, crystallized limestones, and iron containing titanium, of Eozoic age, are abundant in well defined areas in this section, especially about lat. 13° 37′ N. and long. 86° 32′ W. In some places, notably Cerro Lagoonita (a part of the mesas de Totumble) gneiss of Silurian era is found for miles in length, and over 600 feet nearly perpendicular. It is fractured (schistosed) in nearly vertical lines intersected at nearly right angles by other dividing planes that are often over 100 feet apart. In a few places these division lines, where they intersect, have been expanded into caves which extend 100 feet or more into the mountain. Bones of man and other animals are sometimes found in these caves.*

2. *Devonian*, red sandstones: coarse, gritty shales, spotted marls, etc., are found in and near the edges of this section.

There are in this section a few deposits of kaolin, of an unusually pure kind; also veins 6 to 12 inches wide of crystallized translucent quartz; and in several places large masses of albite-porphyry, labradorite-porphyry, orthoclase and anorthite feldspars; and in many places argillaceous slates, cut by dikes and veins, the latter sometimes rich in gold, silver, lead, antimony and tin. Some of these lodes also contain uranium ores mixed with those of tin—others contain nickel. There are also several large deposits of hematite and limonite: in some of the creeks are found platinum and iridium.

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* In reference to bones and caves the Indians tell numerous mythical stories. Some of the crania of man are certainly very early neolithic, or earlier.

ral parts of this section are large elevated plains, and
lually sloping cerros, well watered and very fertile.
from 1,100 to 3,500 feet above the sea, and admirably
or the semi-annual production of large crops of wheat,
rn, sugar, etc.

f the mountains exceed 5,000 feet above the Pacific
,900 to 4,000 feet are the usual limits of altitude.
several large mineral springs in this section, some boil-
volcanoes nor evidences of seismic forces appear. The
mperature of the air is about 20° Cent. and the climate
ul all the year.

Section Fourth.

a strip of territory extending from north to south on
f and adjoining section third, and extending eastward to
out 100 miles of the Carribean coast. Its geological
similar to that described in Section second, but its
s have not been so much disturbed. Coal, iron ores and
e in large deposits; also, near its eastern edge, about

Whitella scofieldi Ulrich, THE AMERICAN GEOLOGIST, Vol. VI, No. 3, p. 180, 1890.

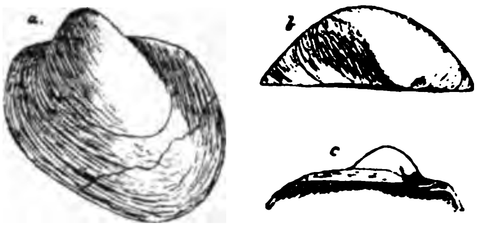


Fig. 16. ***Whitella scofieldi*** **Ulr., Trenton shales, Cannon Falls, Minn., *a*, large left valve, restored in the postero-ventral region. It is possible that the restored portion should be more narrowly rounded. *b*, cardinal view of same; *c*, interior of same to show dentition of hinge, and internal cartilage support within the posterior half of hinge line.**

fined oblique teeth situated about midway between the beak and anterior extremity. The narrow depression between them receives the anterior tooth of the right valve, while the second tooth of that valve must have fitted into an elongate depression beneath and in front of the beak of the left valve. A decided ridge-like thickening is to be observed beneath the posterior third of the hinge line. It increases in strength posteriorly, and, as interpreted by me, served as a support to an internal ligament. The escutcheon or external ligamental area is very narrow, though quite deep, and does not extend in front of the beaks. It is also finely striated longitudinally, a feature that probably pertains to all the species of the genus.

Of external features, the large umbones and the tumid appearance of the shell in general, are the most striking, and seem to indicate closer relationship to *W. umbonata* Ulr. (GEOLOGIST, Sept. 1890,) then at first supposed. Another point in which *W. scofieldi* approaches that species, and in which both differ from all the others, is found in the location of the point of greatest convexity, it being behind the middle of the valve. In *W. umbonata* the point is higher up than in the present species, it being almost exactly at the center of the valves in the latter. A more important difference is found in the escutcheon, which in the species *umbonata*, *obliquata*, *sterlingensis* (M. & W.), *hindi* (Billings) and *compressa*, forms a wide channel extending the whole length of the hinge line, while in *W. scofieldi*, it is narrow and does not extend anteriorly beyond the beaks. The next described species (*W. truncata*) agrees with it in that respect.

l years ago I received, with a number of other fossils, an
cast of a shell that probably belongs to this species.
ssils were collected at Beloit, Wis., from the Buff lime-
f the Trenton, and the cast in question was labeled
rdites megambonus Whitfield. I do not think that it belongs
species, the shell being more oblique, and the umbonal
re pronounced and angular, agreeing in these respects
sely with the *scofieldi*. Another specimen received at the
ime agrees more nearly with the figures of the former
f Wis. Vol. IV, Pl. 5, figs. 7 and 8.) It is compara-
ss ventricose, but being much smaller than the figured
n, it is possible that the difference is due to age.

oth these specimens are unquestionable *Whitella* and not
rdites at all, and the question naturally arises, may not
d's species really belong to the same genus? I am al-
tisfied that it does, despite the fact that Prof. Whitfield
scribes and figures (loc. cit. fig. 7) his species as having
ng, curved, posterior teeth." If his fig. 8, representing
ro-cardinal view of the same specimen is reliable and I

with those of species of *Whitella* and until it is proven that the species really possesses posterior hinge teeth, I shall refer to it as *Whitella megambona.*

Whitella truncata n. sp.

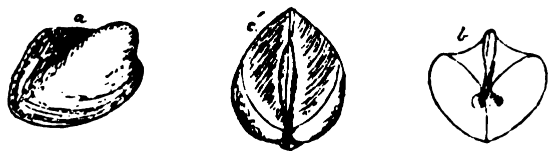


Fig. 17. *Whitella truncata*, n. sp., Galena limestone, Cannon Falls, Minn. *a*, left side of a large cast of the interior; *b*, antero-cardinal view of same; *c*, cardinal view of same.

Shell small, very oblique, ventricose, subrhomboidal in a side view. Beaks nearly terminal, prominent, of moderate size, obliquely enrolled; umbones and umbonal ridge full, the latter angular and traceable to the postero-basal angle. Cardinal slope sharply defined, and distinctly concave; anterior and basal slopes slightly convex and very rapid. Anterior end very short, scarcely projecting beyond the beaks, narrowly rounded, then sloping rapidly backward and uniting very gradually with the gently curved basal margin. Posterior end truncated, straightened, forming nearly a right angle with the hinge line, and one of from 75° to 80° with the ventral edge.

Escutcheon narrow, not extending anterior to the beaks. In casts of the interior, the internal cartilage support leaves two narrow impressions, one on each side of the posterior half of the hinge line. Dentition of hinge not observed. Muscular scars very faint.

Dimensions of a large cast of the interior: Greatest hight, 13 mm.; greatest convexity (near center of shell) 15 mm.; length from beaks to postero-basal angle, 19 mm.; length from anterior extremity to upper portion of posterior margin 15 mm. In a small specimen only 6 mm. high, the other dimensions are in proportion, except that the convexity is comparatively less.

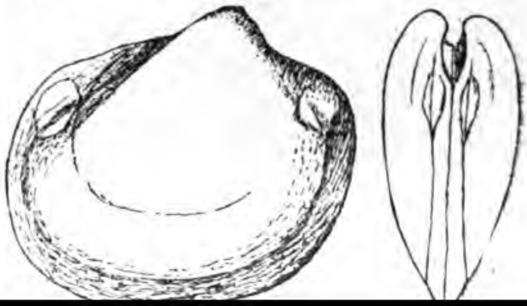
This species is closely related to *W. scofieldi*, but may be distinguished by its smaller size, greater convexity, truncated posterior end, shorter anterior end, and more pronounced postero-ventral angle.

Associated with this species, I found a cast of another species of this genus, reminding one strongly of *W. obliquata* Ulr. It is,

, not the same as that species, being smaller, more , and with the postero-basal angle sharper. The impres- the internal ligament supports are also much wider and than in that species. I conclude therefore that it rep- distinct species which might be called ***Whitella præcipta,***

n and locality: Shaly layers of the Galena limestone, asso- ith *Receptaculites* and *Hemipronites americana* Whitfield.

Whitella subovata, n. sp.



ward very gently and uniformly into the basal margin; posterior end generally uniformly rounded, but occasionally the basal portion is a little produced. Escutcheon or ligamental area deep and wide, extending to the anterior extremity of the hinge. Internal ligament supports not leaving any appreciable impressions on casts of the interior. Muscular scars and pallial line unusually distinct. Surface with concentric lines of growth.

Cypricardites grandis, n. sp.

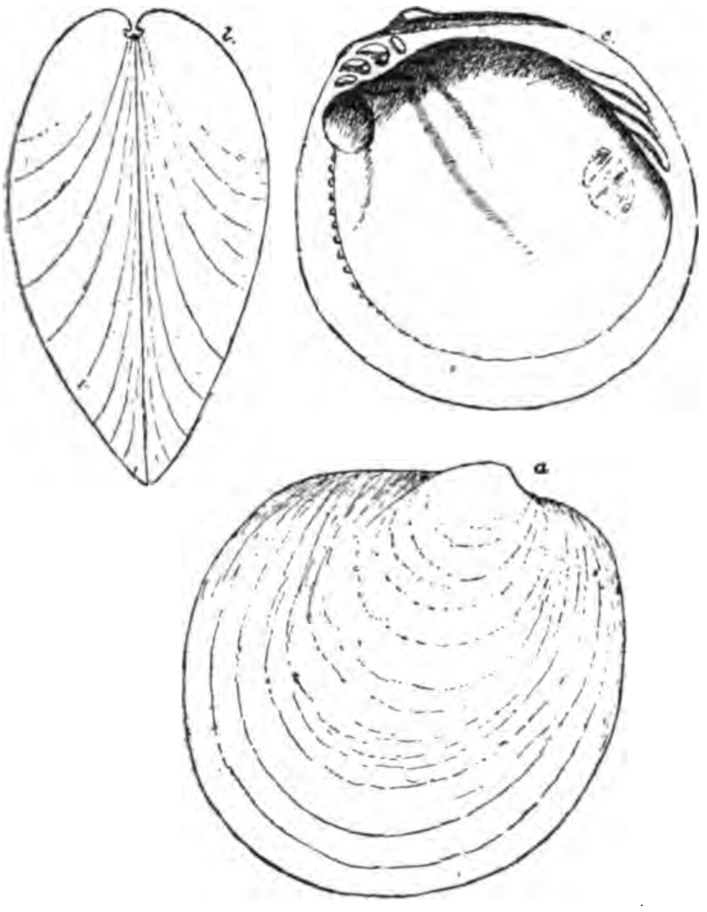


Fig. 19. *Cypricardites grandis*, n. sp., Galena horizon of the Trenton group, near Burgin, Ky. *a*, right side of a perfect shell of this species; *b*, anterior view of same; *c*, interior of right valve as obtained from gutta-percha impressions of casts of the interior.

This species resembles the Minnesota Trenton shales species, *pressa*, rather closely, but is distinguished from it, as well all the others of the genus, by the suboval outline. The e not nearly so ventricose as those of *W. obliquata* and *ta*, with which it is associated.

on and locality: Upper beds of the Cincinnati group, at ille, Ohio, and other localities.

large, moderately ventricose, slightly oblique, the outline ılar. Beaks small, projecting slightly above the hinge liquely incurved, almost in contact; situated about in the of the anterior half of the cardinal margin. Umbonal conspicuous, the slope of the surface to the postero-cardi- gin gradual and slightly concave, the slope to the basal rior margins very gently convex; point of greatest con- little above the center of the shell. Anterior end longer of the beaks than usual in this genus, the margin nar- unded above, then with a very gentle and almost uniform rd and backward curve merging imperceptibly into the nd later into the posterior margin. Antero-cardinal edge produced; likewise the postero ventral, but in most cases

This fine species is related to *C. canadensis* Billings, and *C. ventricosus* Hall, particularly the former, but both those species are much more oblique and decidedly ovate instead of subcircular. *C. wortheni* Ulrich, (Ill. Geol. Surv., Vol. 3, Pl. 3, Fig. 9) is also very near, but is more ventricose and less oblique, and has the beaks (in casts of the interior) farther apart, indicating a more massive hinge plate. There is also one posterior tooth less in each valve of that species.

Another close relation is found in the "Buff limestone" of the Trenton at Beloit, Wis. It was sent to me as *C. niota* Hall, but is clearly not that species, being of a more circular shape, and less ventricose, with the surface of the cast also more evenly convex. From *C. grandis* it differs in having the beaks nearer the anterior extremity, and only two instead of three posterior hinge teeth. The latter are also more delicate, and the shell smaller.

Position and locality: Upper beds of the Trenton limestone (Galena horizon), one mile south of Burgin, Ky. It is also to be found at Harrodsburg and other localities, but good specimens are rare.

REVIEW OF RECENT GEOLOGICAL LITERATURE.

A Geological Reconnaissance in southwestern Kansas. By ROBERT HAY. pp. 49; with 2 plates, and 21 figures in the text. (Bulletin of the U. S. Geol. Survey, No. 57, 1890.) A geologic map of the southwest part of Kansas, including the region about Wichita and westward, crossed by the Arkansas river, forms the frontispiece of this report and numerous sections are given in the second plate and in the text. The bed-rocks are Carboniferous shales and limestone, at Wichita and eastward; unfossiliferous Jura-Trias shales, clays, limestone and sandstone, mainly red, estimated 550 feet in total thickness, well developed southwest of Wichita and on the Cimarron river; the Cretaceous series, of which the Dakota, Fort Benton, and Niobrara formations are recognized, extending from Wichita west along the Arkansas to the 100th meridian; and Tertiary grit and marl, apparently the representatives of the Loup Fork and Equus beds of Cope, occupying most of the southwestern quarter of Kansas.

In the upper part of the Jura-Trias is found a noteworthy bed of white gypsum, 12 to 15 feet thick; and beneath the prevailingly red beds of this series, borings pass through some 370 feet of gray shales, enclosing in their lower part several layers of rock-salt from 2 to 11 feet

ıess, as described by Mr. Hay in the GEOLOGIST, February, 1890.
ferous beds are referred provisionally to the Triassic system,
› the Jura-Trias, with this addition, a thickness of more than
t in the southern part of this state.
ıaternary deposits noted in this reconnaissance are five, denom-
n ascending order, gumbo, earlier gravel, loess, later gravel,
ium.

*ıe Relations between the Geology of Eastern Maine and New
ck.* By L. W. BAILEY. [Transactions of the Royal Society
a for the year 1889, Vol. VII (Montreal, 1890) sec. IV, pp.
Professor Bailey first gives a general review of the more im-
ıapers describing the geology of this region. A remarkable
oticed, which was early recognized by Billings and later has
sidered by Sir Wm. Dawson, that features are presented by
the fossiliferous horizons of the East which are very different
se of the more westerly portions of the continent, and show a
lationship with those of Europe. The rocks of Deer Island
po Bello, which professor Shaler compared with the Cambrian
ıut Cambridge and Boston, are still regarded as Pre-Cambrian
ably Huronian. The Perry group, the flora of which has been
escribed by Dawson, is considered to be true Devonian and is
ost nearly resemble the Catskill of New York. It will be
red that on the maps of the Canadian survey this group was
s Lower Carboniferous and defined by Bailey and Matthew as

drift, belonging to the second glacial epoch, found in the Mississippi basin scores of miles and in part two hundred miles or more to the north. The hypothesis of a glacial dam across the Ohio at Cincinnati, which Prof. Wright had previously presented before the American Association and in his "Ice Age in North America," is here more fully considered; but President Chamberlin holds that if such an ice-dam at any time ponded back the water of the Ohio, it was only for brief times, being comparable with ice-gorges of recent spring floods, though on a much grander scale. The terraces of the Ohio seem clearly referable to fluvial action, having slopes of descent much like the present river; excepting certain slender horizontal terraces that have been noted by Mr. McGee, and perhaps others reported by Prof. I. C. White, which may be due to the obstruction of the valley at Cincinnati by the ice-sheet during its stage of maximum advance.

LIST OF RECENT PUBLICATIONS.

1. *State and Government reports.*

California state mining Bureau; Catalogue of the State Museum, vol. 4. Wm. Irelan.

Annual report of the territorial geologist, Wyoming, Jan., 1890, Louis D. Ricketts.

2. *Proceedings of Scientific Societies,*

Proceedings of the Colorado Scientific Society, vol. iii, part ii, 1889, contains: Remarks on the plication of the coal measures in southeastern Colorado and northeastern New Mexico, P. H. Van Diest; Etched beryls from Mt. Antero, Colorado, R. C. Hills; Analyses of three descloizites from new localities, W. F. Hillebrand; Notes on the aboriginal remains near Denver, Colorado, Geo. L. Cannon, Jr.; The plasticity of glacier ice, John F. Main; Stereo-chemistry, Chas. S. Palmer; Additional notes on the Huerfano beds, R. C. Hills; Additional notes on the eruptions of the Spanish Peaks region, R. C. Hills; Notes on the occurrence of sesqui-sulphate of iron in New Mexico, Richard Pearce; Sublimated tellurium, Richard Pearce; Preliminary paper on the eruptive rocks of Boulder county, and adjoining counties, Colorado, Chas. S. Palmer; and the address of the retiring president (Richard Pearce) on the Paragenesis of the gold-bearing ores.

Contributions to the Tertiary fauna of Florida, with special reference to the Miocene silex-beds of Tampa, and the Pliocene beds of the Caloosahatchie river, W. H. Dall, (vol. iii. of the Trans. of the Wagner Free Institute, Philadelphia).

3. *Papers in Scientific Journals.*

The Ottawa Naturalist, *Sept.*, 1890. Serpentines of Canada, N. Jiroux; *Oct.*, Ideas on the beginning of life, J. Ballantyne.

Bulletin of the American Geographical Society, vol. xxii. No. 3, *Sept.*, 1890, contains: Canada, the land of waterways, Watson Griffin; Modern

. S. Smith ; Some notes on the upper Amazon, Courtenay De

nerican Antiquarian, *Sept.* contains : The difference between
ıd Mound-builders' relics, Stephen D. Peet ; Symbolism among
ns and standing stones of France, A. S. Packard.
an Naturalist, *Sept.* No., Newly discovered glacial phenomena
aver valley, P. Max Foshay and R. R. Rice.
lings of the Can. Institute, Toronto, *April*, 1890. Geology of
west of Lake Superior, Arthur Harvey ; Kamanistiquia silver-
elt, Herbert R. Wood.
ır. Sci., *Aug.* No. : Curious occurrence of vivianite, W. L.
Classification of the glacial sediments of Maine, Geo. H. Stone;
ver Silurian graptolites from northern Maine, W. W. Dodge ;
asins of the Hudson River epoch, James P. Kimball ; Two
rite irons, F. P. Venable ; Notice of some extinct testudinata,
sh. *Sept.* : Rocky Mountain protaxis, and the Post-Cretaceous
-making along its course, J. D. Dana ; Chalcopyrite crystals
French Creek iron mines, Chester Co., Pa., L. S. Penfield ;
ıa and related genera, C. E. Beecher ; Notice of two new iron
from Hamilton county, Texas, E. E. Howell ; The Cretaceous
ba, J. B. Tyrrell ; On mordenite, L. V. Pirsson ; Geology of
s island, Mobile bay, D. W. Langdo ; On Leptænisca, a new
brachiopod from the Lower Helderberg group, Chas. E.
North American species of Strophalosia, Chas. E. Beecher ;

Electro-chemical Analysis. Edgar F. Smith, 16 mo., pp. 116, P. Blakiston, Son and Co., Philadelphia.

The persistence of plant and animal life under changing conditions of environment. Persifor Frazer. The American Naturalist. June, 1880.

On variation, with special reference to certain paleozoic genera. Jos. F. James. The American Naturalist, December. 1889.

On the geology and physiograghy of a portion of northwestern Colorado and adjacent parts of Utah and Wyoming. C. A. White. Ninth annual report of the director, U. S. Geol. Sur.

Some metamorphosed eruptives in the crystalline rocks of Maryland, Wm. H. Hobbs. (Trans. Wis. Acad. Sci., Arts and Letters. vol. viii, pp. 155–159).

Some Ontario magnetites, T. D. Ledyard. (Trans. Am. Inst. Min. Eng.).

A summary of progress in mineralogy and petrography in 1889, W. S. Bailey (From monthly notes in the American Naturalist).

The first oil well, the birth of a great industry, J. S. Newberry. (Harper's Magazine, Oct., 1890).

Discovery of fossils in the limestones of Frederick county, Md., Charles R. Keyes (Johns Hopkins University circulars, No. 83).

Description of new meteorites, by E. E. Howell. (Proc. Rochester Acad. Science, vol. i). The meteorites described are Welland, Hamilton, Puquois, De Cewsville, Dona Inez and Llano del Inca, El Chanaralino. La Primitiva and Calderilla.

Barometric observations among the high volcanoes of Mexico, with a consideration of the culminating point of the North American continent, A. Heilprin, (Proc. Acad. Nat. Sci. Phil., Oct., 1890).

On Syringotheris, Winchell, and its American species, Charles Schuchert, (Ninth annual Report N. Y. state geologist, 1890).

List of species of the American paleozoic Orthis, Spirifera, Spiriferina and Syringotheris, Chas. Schuchert, (Ninth annual Rep. N. Y. state geologist).

Notes on the serpentinous rocks of Essex county, N. Y., from aqueduct shaft 26, New York City, and from near Easton, Penn., Geo. P. Merrill (Proc. U. S. Nat. Museum, vol. xii, pp. 595-600).

On certain Mesozoic fossils from the islands of St. Paul's and St. Peter's in the straits of Magellan. C. A. White. (Proc. U. S. Nat. Mus. vol. xiii, pp. 13 14).

Description of new forms of Upper Cambrian fossils, C. D. Walcott, (Proc. U. S. Nat. Mus. vol. xiii, pp. 266–279).

5. *Foreign publications.*

Faune du calcaire D'Erbray (Loire inférieure). Par Charles Barrois. Contribution à l'étude du terrain Devonien de l'ouest de la France. Mem. Soc. géol. du Nord. Tome troisième, 1889.

Geologische Untersuchungen am Westabhange des Urals. Von A. Karsnopolsky (mit 2 Tafl. u. 15 Holzsch. im Texte). Mem. du Comité géologique. St. Petersburg. 4to., 522 pp.

. Erforsch. des auf d. 48-sten Blatt der allgemeinen geolog-
rte Russland's dargestellten Gebietes. Krystallinische Ges-
s Kreidesystem. Das tertiäresystem. Pliocän. Das post-
stem. Mem. d. Comité Geol. Russlands, 4 to. 262 pp.
nty-seventh volume of the Oberhess. Gesell. f. Natur und
contains the following geological papers: Neue Funde von
, Gesteinen und Versteinerungen aus der Umgegend von Gies-
ENG; Ueber den Melanophlogit, A. STRENG; Eine neue Lima-
m Oligocän des Mainzer Beckens, G. GREIM; Ueber eine
liche Säulenbildung im Tagebau des Braunsteinbergwerks in
ner Mark, J. UHL; Ueber Regentropfenspuren ebendaselbst,

de la société géologique du Nord, tome xvi, 188–89, contains:
ns sur la constitution géologique de l'ouest de la Bretagne
as. Barrois; Les dépots phosphatés de Montay et de Forest,
re; Grès dit Porphyre de Gognies–chaussée, L. Cayeux;
r les gites de Phosphate de chaux du Nord de la France, M.
Le bassin houiller de Valenciennes d'apres les travaux de
ry et R. Zeiller, Ch. Barrois; L'Age des Sables de Cerfontaines
ies, L. Cayeux; Sur la présence de Trilobites dans les schistes
-de-vin des environs de Rennes, Bézier; L'Ardenne, J. Gos-
crustacés dévoniens de l'état de New York, d'apres M.

Földtani Közlöny, der ungarischen geologischen Gesellschaft, Bd. xx, 5-7 heft, contains, in the supplement: Spuren des Höhlenbären (Ursus spelæus Blum.) in Ungarn, G. Primics: Dicksonia punctata Stbg. sp. in der fossilen Flora Ungarns, M. Staub;

Mittheilungen des Vereins für Erdkunde zu Leipzic, 1889, contains: Physikalische und geologische Verhältnisse des Chiemsees, E. Bayberger; Stabsarzt Dr. Ludwig Wolf, Friedrich Ratzel, with a portrait;

Bulletins du comité géologique, St. Petersbourg, vol. viii, Nos. 9-10, contains: Récherches microscopiques sur les roches et minerais du gisement Sawodinskoïe (Altai), Mikloucho-Maclay. Vol. ix, Nos. 2-3, contains: Note sur le calcaire Carbonifère du bassin de Moscou, S. Nikitin. Vol. ix. No. 5, contains: Note sur les gisements des minerais de fer dans le district de Berdimsk du government de Tauride, N. Sokolov. Bibliothèque géologique de la Russie, 1889, Supplement to vol. ix.

Neuere Breiträge zur Epigraphie des dacischen Erzgebirges und Bergbaues, G. Teglas.

Mittheilungen der naturforschenden Gesellschaft in Bern, aus dem Jahre 1889, contains: Löss und lössähnliche Bildungen in der Schweiz, Fr. Jenny; Ueber den Hautschild eines Rochen aus der marinen Molasse, A. Baltzer;

Transactions of the Edinburgh Geological Society, vol. vi, Part i, contains: Darwin's geological work, Ralph Richardson; The classification, distribution, origin and evolution of the normal micas, Alexander Johnstone; Note on the supposed high-level shell beds in Easter Ross, Hugh Miller; On the succession of the Lower Carboniferous series to the West of Edinburgh, with special reference to the district around Cramond, John Henderson: An old man and woman, or Human bones in a Scrobicularia bed at Newton Abbot, Devonshire, William Pengelly: Improvements in the methods of determining the composition of Minerals by blowpipe analysis, Alexander Johnstone; Recent progress in paleontology as regards invertebrate animals, H. A. Nicholson.

On composite spherulites in obsidian, from Hot Springs near Little lake, California, Frank Rutley (Quart. Jour. Geol. Soc. vol. xlvi. Aug., 1890).

Class-book of Geology, Arch. Geikie, 2nd edition, 12mo. 404 pp. Mcmillan & Co., London and New York.

Reports of geological explorations during the years 1888-9 (New Zealand), Wellington, 1890. James Hector, director. Besides the report of progress by the director, there are lengthy reports by A. McKay and J. Park. Large octavo, numerous illustrations and maps.

6. Scientific Laboratories and Museums.

Bulletin of the scientific laboratories of Denison University, vol. v, contains: The Waverly group, W. F. Cooper; Tabulated list of fossils known to occur in the Waverly group of Ohio, W. F. Cooper.

Bulletin of the American Museum of Natural History, vol. iii., No. 1, contains: The Calciferous formation in the Champlain valley, Brainerd and Seely; Observations on the fauna of the rocks at Fort Cassin, Vermont, with descriptions of a few new species; Observations on a

from the Eocene beds of Wyoming, R. P. Whitfield; Descrip-
ew genus of inarticulate brachiopodous shell, R. P. Whitfield.
from the laboratories of natural history of the state univer-
a, contains the conclusion of the paper by B. Shimek on the
its fossils.
of the Mus. Comp. Zool., Cambridge, vol. xvi., No. 9, On
re from Marblehead neck, Mass., John H. Sears.

CORRESPONDENCE.

CENE SUBMERGENCE OF THE ISTHMUS OF PANAMA. Since the
f my article in this number, I have found the original report
. Maack, which forms pages 155–175 of Reports of Explora-
Ship Canal, Isthmus of Darien, Navy Department, Wash-
74. This strongly confirms my suggestion that at least the
s of the isthmus were probably submerged during the Glacial
r the fossils collected by Dr. Maack are described by him as
g in the sea," and "all living up to the present time," show-
mation to be of Pleistocene age. He does not, however, use

to a legitimate conclusion the method of Dr. Nicholson and why cannot Rominger follow unless it is that he is timid about venturing away from his ancient land marks. On a previous occasion Mr. Joseph James (*vide* Journal of the Cincinnati Society of Natural History, vol. x. p. 118 et seq.) found fault with Mr. Ulrich's subdividing so extensively the genus Monticulipora and giving each division a generic rank, deeming it a useless cumbering of nomenclature, and productive of endless confusion in the study of a confessedly difficult group of fossils.

These attacks on the new method of dealing with the monticuliporoids and other paleozoic Bryozoa, could be suffered to pass unnoticed, were it not that the host of onlookers might think Mr. Ulrich stood alone in the conflict. It is not so, Mr. Aug. F. Foerste and Mr. A. H. Foord have used this method of work in their labors on the Bryozoa. The new method will prevail. It is but the outcome of a more correct understanding of nature and her ways of working. And the periodical objections of those used to the old ways and unable to catch the spirit of the new, are to be expected and are as harmless to real progress as youth's first love to his eventual well being.

That the external characters of the monticuliporoids are insufficient for classification and produce artificial assemblages no longer needs proof. Those who base their classification upon internal characters and structure do not neglect the external features nor hesitate to make use of them whenever possible. Often external characters are correlated with internal but not always. That Dr. Rominger has failed to grasp Mr. Ulrich's genera should not induce him to hastily charge the failure to the genera. It may be due to his own lack of perceptive powers. And that the effort should have produced in him a "dreadful agony near to fainting" arouses one's pity.

We may notice more in detail some of Dr. Rominger's statements. He speaks of "trifling modifications." This seems a clear case of trying to belittle points of difference. What is it that makes a modification "trifling?" Who shall say that the presence or absence of acanthopores (spiniform corallites of Rominger) does not betoken some difference and perhaps a great one, in the anatomical structure. The view advanced by Dr. Rominger to explain the origin of the spiniform corallites, for which Nicholson and Foord have proposed the term acanthopores, seems to me entirely unsupported by the evidence he offers. The majority of observers have considered these to be tubules, which in some cases the doctor admits; but he says the center is not well defined and so thinks they were not regular tubules tenanted by peculiarly modified zooids, as Dr. Nicholson conjectures, or vibracula as Mr. Ulrich supposes, but were formed by a superabundance of schlerenchyma in certain parts of the wall tissue: basing this view upon the manner in which the walls are formed of layers projecting obliquely upward and outward. He argues that if they were tubules in structure, they should have been constructed in the same manner as the others. But why? It would seem a reasonable supposition that the tubule, if the home of an appendage of the nature of a vibraculum, as is probable,

he zoarium grew need to keep near the surface and the tubule
gradually abandoned behind it and filled up; and thus the
hollow part not be sharply defined. If "the spinules are an
part of the ordinary tube-walls, whose margins by exuberance
on of shell matter, form nodular prominences in certain spots
ircumferences, which, amalgamating with similar prominences
ing tube-walls, constitute the spinules," why does it happen
apparently purposeless exuberant secretion of adjoining walls
ppens at the same place so as to form a tubule. I cannot see
v these tubules would always be so regular in form and con-
osition and numbers as observation proves them to be.

s show, so far as the nature of preservation will permit, that
res are built up in the same manner as the zoœcia, *i. e.*, of
inverted cone-shaped layers. Furthermore Nicholson has
phragms in the acanthopores of Batostomella gracilis James
onticulipora, p. 126, fig 20E.), and Mr. Ulrich has observed
ther forms. Waagen and Wentzel consider the acanthopores
young tubules.

ctor states that "in parts of one and the same specimen spin-
ften abundantly developed, while in other parts of the surface
ntirely missing or only thinly scattered," and regards this as
tory indication that their functional importance cannot be

is no difficulty whatever in distinguishing the large acanthopores of Dekayia from the smaller ones of other monticuliporoids and that too "without a defined standard of magnitude." But were this so, the genus Dekayia is not based on this feature alone but upon others also.

Diplotrypa and Prasopora our author would throw together because by making incomplete vesicular diaphragms (cystiphragms) occur in Diplotrypa and complete diaphragms in some of the tubes of Prasopora, he can find no essential point of difference. But his observation, if ever he has made any on these genera, is wrong. Every specimen of Prasopora always has cystiphragms and no specimen of Diplotrypa ever has them. If his sections of Prasopora sometimes show straight diaphragms in the zoœcia, this is due to the manner in which the section is made. The cystiphragms form a continuous row lining one side of the zoœcial cavity. A longitudinal section through the zoœcial chamber in one direction cuts all the cystiphragms; made at right angles it cuts none of them but does cut the diaphragms which are also found in the zoœcial chamber. Hence the doctor has hastily concluded that such tubes contain no cystiphragms. Other differences between the genera might be pointed out, but I have no desire to write a treatise on the subject here. By a similar process of minimizing and overlooking differences, the doctor would discard Peronopora.

When Mr. Ulrich in defining the genus Atactoporella sums up the characters distinguishing it from Atactopora, and uses the phrase "these are all good generic characters," he is not seeking consolation for establishing a new genus, but is showing how per force a new genus must be established. The summary which Dr. Rominger gives of Mr. Ulrich's genera is garbled and hypercritical and to the highest degree unjust. If Lioclema does not belong to the monticuliporoids, where will the doctor put it? There is no questioning its relation to Batostomella.

If the doctor were seriously called upon to deal with the 250 described species, besides an additional host of forms known but as yet undescribed, all of which from his standpoint would have to be placed under Monticulipora, would he not be very apt to split up the genus? And if so, would he call the groups genera or subgenera? It is strange that in every instance where it is likely that he has had an opportunity to fully study certain types, his conclusions approximate those of Mr. Ulrich: for instance, Callopora, Fistulipora, Lioclema, Stenopora, all of which he accepts and seems inclined to magnify their distinctness. If he had sufficiently ample material and the wish and energy to subject it to full investigation, would he not out-Ulrich Ulrich himself.

And finally this ought to be said that Dr. Rominger ought to have been fair enough to have waited before passing sentence of condemnation until the result of Mr. Ulrich's mature studies should appear in volume viii. of the Geological Survey of Illinois, a perusal of which may have the effect of considerably modifying his views.

Sparta, Ill., Sept. 25, 1890. J. M. Nickles.

OR THE DETERMINATION OF EARTH MOVEMENTS. As I was
ne connected with the Pensylvannia railroad, I am well ac-
with the accurate methods of their engineering corps, and the
in one of our papers, during the last year, that some of the
e verifying the accuracy of certain bench marks, that were
o be inaccurate, made me think that it would not be a bad
our United States Geological Survey to obtain copies of the
ks of the dozen, or more, trunk lines that cross the moun-
the Atlantic and Pacific borders, with the dates of survey by
y were established. If we study earth movements near the
ave a datum line for ready reference. A persistence in a
n the bench marks of a definite region, that are connected
will indicate an earth movement with great accuracy, and a
lation of the records of the various level surveys of the rail-
d will, in time, furnish data for a complete discussion of the

Yours truly,

EDWARD H. WILLIAMS, Jr.

niversity, Bethlehem, Pa., Nov. 13, 1890.

OQUOIS BEACH. In reading Prof. Spencer's essay on the
each, referred to in your November number, I notice his
n of the ancient lake Iroquois with the present gulf of Obi,
ing that these sheets of water are alike in having open con-
th the sea. But is it not true that rivers run only *into* the
i while a large river ran *out* of lake Iroquois, its course having

six ballots were received; of these thirty-three were in favor of Washington.

These represent the members from Great Britain, France, Germany, Australia, Austria, Belgium, Hungary, India, Italy, Portugal, Roumania, Russia, and the United States. No negative votes were received from countries outside America.

The majority of the Bureau, as well as a majority of the American Committee, thus expressing their preference for Washington, it was voted to hold the next session of the International Congress of Geologists in Washington, during the week beginning with the last Wednesday (26th) of August next.

The vacancy in the committee caused by the death of Mr. C. A. Ashburner, was filled by the election of Mr. S. F. Emmons, Washington, D. C.

The committee now consists of the following members: Messrs. Branner, Chamberlin, Dana, Dutton, Davis, Emmons, Gilbert, Hall, Hague, Heilprin, Hitchcock, Leidy, Lesley, Le Conte, Marsh, Newberry, Powell, Proctor, Shaler, Stevenson, A. Winchell, Walcott, Whitfield and H. S. Williams.

During this meeting vacancies were filled and the organization of the Committee perfected, so that the present officers and sub-committees are as follows:

Chairman,	J. S. Newberry,	New York City.
Vice-Chairman,	G. K. Gilbert,	Washington, D. C.
Secretaries,	H. S. Williams,	Ithaca, N. Y.
	S. F. Emmons,	Washington, D. C.
Acting Treasurer,	S. F. Emmons,	Washington, D. C.

(1) A sub-committee on the *Scientific Programme:*

J. W. Powell, Chairman,	Washington, D. C.
J. D. Dana,	New Haven, Conn.
T. C. Chamberlin,	Madison, Wis.

(2) A sub-committee on *Longer Excursions:*

Clarence Dutton, Chairman,	Washington, D. C.
N. S. Shaler,	Cambridge, Mass.
J. J. Stevenson,	New York City.

(3) A local sub-committee to make preparations for holding the meeting in Washington, with power to organize and add to their number:

Messrs. Dutton, Gilbert, Hague, Emmons, Powell, and Walcott, all of Washington, D. C.

(4) A nominating sub-committee to nominate officers for the Congress:

J. J. Stevenson, Chairman,	New York City.
T. C. Chamberlin,	Madison, Wis.
Alex. Winchell,	Ann Arbor, Mich.

The following resolutions were adopted:

That the secretaries be authorized to prepare a circular of information, stating the organization, the time of meeting, and such

nformation regarding the Congress as may be thought nec-
in English and in French, to be signed by the chairman
secretaries, and distributed among those likely to be in-
l in this country and in foreign countries.

as further resolved, that the secretary be authorized to
nicate to the editors of the AMERICAN GEOLOGIST and the
an Journal of Science the results accomplished by the
ttee at the present meeting.

it was resolved, that the committee assess its members five
each for expenses.

HE MEETING OF THE BOSTON SOCIETY OF NATURAL HIS-
Nov. 5, 1890, Mr. George H. Barton spoke of his work the
mmer in mapping the drumlins of Massachusetts, under
ection of Prof. N. S. Shaler, for the U. S. Geological Sur-
The area traversed, which includes several hundred drum-
a belt fifteen to thirty miles wide, extending from Lowell
the Connecticut river.

OTA'S RICH TIN MINES. The Harney Peak Consolidated
mpany lately sent to England $17\frac{3}{4}$ tons of tin ore to be
l. A report from the smelters states that they obtained
his ore, 12 cwts., 1 qr., 14 lbs. of refined tin, which is 3.48
t. As the Cornish mines only yield about 2 per cent., it

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